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Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading[1]

This standard is issued under the fixed designation D 5755; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers a procedure to (*a*) identify asbestos in dust and (*b*) provide an estimate of the surface loading of asbestos in the sampled dust reported as the number of asbestos structures per unit area of sampled surface.

1.1.1 If an estimate of the asbestos mass is to be determined, the user is referred to Test Method D 5756.

1.2 This test method describes the equipment and procedures necessary for sampling, by a microvacuum technique, non-airborne dust for levels of asbestos structures. The non-airborne sample is collected inside a standard filter membrane cassette from the sampling of a surface area for dust which may contain asbestos.

1.2.1 This procedure uses a microvacuuming sampling technique. The collection efficiency of this technique is unknown and will vary among substrates. Properties influencing collection efficiency include surface texture, adhesiveness, electrostatic properties and other factors.

1.3 Asbestos identified by transmission electron microscopy (TEM) is based on morphology, selected area electron diffraction (SAED), and energy dispersive X-ray analysis (EDXA). Some information about structure size is also determined.

1.4 This test method is generally applicable for an estimate of the surface loading of asbestos structures starting from approximately 1000 asbestos structures per square centimetre.

1.4.1 The procedure outlined in this test method employs an indirect sample preparation technique. It is intended to disperse aggregated asbestos into fundamental fibrils, fiber bundles, clusters, or matrices that can be more accurately quantified by transmission electron microscopy. However, as with all indirect sample preparation techniques, the asbestos observed for quantification may not represent the physical form of the asbestos as sampled. More specifically, the procedure described neither creates nor destroys asbestos, but it may alter the physical form of the mineral fibers.

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 1193 Specification for Reagent Water[2]

D 3195 Practice for Rotameter Calibration[3]

D 3670 Guide for Determination of Precision and Bias of Methods of Committee D22[3]

D 5756 Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Mass Surface Loading[3]

D 6620 Practice for Determining a Detection Limit for Asbestos Measurements Based on Counts[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *asbestiform*—a special type of fibrous habit in which the fibers are separable into thinner fibers and ultimately into fibrils. This habit accounts for greater flexibility and higher tensile strength than other habits of the same mineral. For more information on asbestiform mineralogy, see Refs **(1)**,[4] **(2)** and **(3)**.

3.1.2 *asbestos*—a collective term that describes a group of naturally occurring, inorganic, highly fibrous, silicate dominated minerals, which are easily separated into long, thin, flexible fibers when crushed or processed.

[1] This test method is under the jurisdiction of ASTM Committee D22 on Sampling and Analysis of Atmospheres and is the direct responsibility of Subcommittee D22.07 on Sampling and Analysis of Asbestos.

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[2] *Annual Book of ASTM Standards*, Vol 11.01.

[3] *Annual Book of ASTM Standards*, Vol 11.03.

[4] The boldface numbers in parentheses refer to the list of references at the end of this test method.

3.1.2.1 *Discussion*—Included in the definition are the asbestiform varieties of: serpentine (chrysotile); riebeckite (crocidolite); grunerite (grunerite asbestos); anthophyllite (anthophyllite asbestos); tremolite (tremolite asbestos); and actinolite (actinolite asbestos). The amphibole mineral compositions are defined according to nomenclature of the International Mineralogical Association **(3)**.

Asbestos	Chemical Abstract Service No.[5]
Chrysotile	12001-29-5
Crocidolite	12001-28-4
Grunerite Asbestos	12172-73-5
Anthophyllite Asbestos	77536-67-5
Tremolite Asbestos	77536-68-6
Actinolite Asbestos	77536-66-4

3.1.3 *fibril*—a single fiber that cannot be separated into smaller components without losing its fibrous properties or appearance.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *aspect ratio*—the ratio of the length of a fibrous particle to its average width.

3.2.2 *bundle*—a structure composed of three or more fibers in a parallel arrangement with the fibers closer than one fiber diameter to each other.

3.2.3 *cluster*—a structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group; groupings of fibers must have more than two points touching.

3.2.4 *debris*—materials that are of an amount and size (particles greater than 1 mm in diameter) that can be visually identified as to their source.

3.2.5 *dust*—any material composed of particles in a size range of <1 mm.

3.2.6 *fiber*—a structure having a minimum length of 0.5 µm, an aspect ratio of 5:1 or greater, and substantially parallel sides **(4)**.

3.2.7 *fibrous*—of a mineral composed of parallel, radiating, or interlaced aggregates of fibers, from which the fibers are sometimes separable. That is, the crystalline aggregate may be referred to as fibrous even if it is not composed of separable fibers, but has that distinct appearance. The term fibrous is used in a general mineralogical way to describe aggregates of grains that crystallize in a needle-like habit and appear to be composed of fibers. Fibrous has a much more general meaning than asbestos. While it is correct that all asbestos minerals are fibrous, not all minerals having fibrous habits are asbestos.

3.2.8 *indirect preparation*—a method in which a sample passes through one or more intermediate steps prior to final filtration.

3.2.9 *matrix*—a structure in which one or more fibers, or fiber bundles that are touching, are attached to, or partially concealed by a single particle or connected group of non-fibrous particles. The exposed fiber must meet the fiber definition (see 3.2.6).

3.2.10 *structures*—a term that is used to categorize all the types of asbestos particles which are recorded during the analysis (such as fibers, bundles, clusters, and matrices). Final results of the test are always expressed in asbestos structures per square centimetre.

4. Summary of Test Method

4.1 The sample is collected by vacuuming a known surface area with a standard 25 or 37 mm air sampling cassette using a plastic tube that is attached to the inlet orifice which acts as a nozzle. The sample is transferred from inside the cassette to an aqueous suspension of known volume. Aliquots of the suspension are then filtered through a membrane. A section of the membrane is prepared and transferred to a TEM grid using the direct transfer method. The asbestiform structures are identified, sized, and counted by TEM, using SAED and EDXA at a magnification of 15 000 to 20 000X.

5. Significance and Use

5.1 This microvacuum sampling and indirect analysis method is used for the general testing of non-airborne dust samples for asbestos. It is used to assist in the evaluation of dust that may be found on surfaces in buildings such as ceiling tiles, shelving, electrical components, duct work, carpet, etc. This test method provides an index of the surface loading of asbestos structures in the dust per unit area analyzed as derived from a quantitative TEM analysis.

5.1.1 This test method does not describe procedures or techniques required to evaluate the safety or habitability of buildings with asbestos-containing materials, or compliance with federal, state, or local regulations or statutes. It is the user's responsibility to make these determinations.

5.1.2 At present, no relationship has been established between asbestos-containing dust as measured by this test method and potential human exposure to airborne asbestos. Accordingly, the users should consider other available information in their interpretation of the data obtained from this test method.

5.2 This definition of dust accepts all particles small enough to pass through a 1 mm (No. 18) screen. Thus, a single, large asbestos containing particle(s) (from the large end of the particle size distribution) dispersed during sample preparation may result in anomalously large asbestos surface loading results in the TEM analyses of that sample. It is, therefore, recommended that multiple independent samples are secured from the same area, and that a minimum of three samples be analyzed by the entire procedure.

6. Interferences

6.1 The following minerals have properties (that is, chemical or crystalline structure) which are very similar to asbestos minerals and may interfere with the analysis by causing a false positive to be recorded during the test. Therefore, literature references for these materials must be maintained in the laboratory for comparison to asbestos minerals so that they are not misidentified as asbestos minerals.

6.1.1 *Antigorite*.

6.1.2 *Palygorskite (Attapulgite)*.

6.1.3 *Halloysite*.

6.1.4 *Pyroxenes*.

6.1.5 *Sepiolite*.

6.1.6 *Vermiculite scrolls*.

[5] The non-asbestiform variations of the minerals indicated in 5.1.3 have different Chemical Abstract Service (CAS) numbers.

6.1.7 *Fibrous talc*.

6.1.8 Hornblende and other amphiboles other than those listed in 3.1.2.

6.2 Collecting any dust particles greater than 1 mm in size in this test method may cause an interference and, therefore, must be avoided.

7. Materials and Equipment

7.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.[6]

7.2 *Transmission Electron Microscope (TEM)*, an 80 to 120 kV TEM, capable of performing electron diffraction, with a fluorescent screen inscribed with calibrated gradations, is required. The TEM must be equipped with energy dispersive X-ray spectroscopy (EDXA) and it must have a scanning transmission electron microscopy (STEM) attachment or be capable of producing a spot size of less than 250 nm in diameter in crossover.

7.3 *Energy Dispersive X-ray System (EDXA)*.

7.4 *High Vacuum Carbon Evaporator*, with rotating stage.

7.5 *High Efficiency Particulate Air (HEPA)*, filtered negative flow hood.

7.6 *Exhaust or Fume Hood*.

7.7 *Particle-free Water* (ASTM Type II, see Specification D 1193).

7.8 *Glass Beakers* (50 mL).

7.9 *Glass Sample Containers*, with wide mouth screw cap (200 mL) or equivalent sealable container (height of the glass sample container should be approximately 13 cm high by 6 cm wide).

7.10 *Waterproof Markers*.

7.11 *Forceps* (tweezers).

7.12 *Ultrasonic Bath*, table top model (100 W).

7.13 *Graduated Pipettes* (1, 5, 10 mL sizes), glass or plastic.

7.14 *Filter Funnel*, either 25 mm or 47 mm, glass or disposable. Filter funnel assemblies, either glass or disposable plastic, and using either a 25 mm or 47 mm diameter filter.

7.15 *Side Arm Filter Flask*, 1000 mL.

7.16 *Mixed Cellulose Ester (MCE) Membrane Filters*, 25 or 47 mm diameter, $\leq$0.22 µm and 5 µm pore size.

7.17 *Polycarbonate (PC) Filters*, 25 or 47 mm diameter, $\leq$0.2 µm pore size.

7.18 *Storage Containers*, for the 25 or 47 mm filters (for archiving).

7.19 *Glass Slides*, approximately 76 by 25 mm in size.

7.20 *Scalpel Blades*, No. 10, or equivalent.

7.21 *Cabinet-type Desiccator*, or low temperature drying oven.

7.22 *Chloroform*, reagent grade.

7.23 *Acetone*, reagent grade.

7.24 *Dimethylformamide (DMF)*.

7.25 *Glacial Acetic Acid*.

7.26 *1-methyl-2-pyrrolidone*.

7.27 *Plasma Asher*, low temperature.

7.28 *pH Paper*.

7.29 *Air Sampling Pump*, low volume personal-type, capable of achieving a flow rate of 1 to 5 L/min.

7.30 *Rotameter*.

7.31 *Air Sampling Cassettes*, 25 mm or 37 mm, containing 0.8µ m or smaller pore size MCE or PC filters.

7.32 *Cork Borer*, 7 mm.

7.33 *Non-Asbestos Mineral*, references as outlined in 6.1.

7.34 *Asbestos Standards*, as outlined in 3.1.2.

7.35 *Tygon*[7] *Tubing*, or equivalent.

7.36 *Small Vacuum Pump*, that can maintain a pressure of 92 kPa.

7.37 *Petri Dishes*, large glass, approximately 90 mm in diameter.

7.38 *Jaffe Washer*, stainless steel or aluminum mesh screen, 30 to 40 mesh, and approximately 75 mm by 50 mm in size.

7.39 *Copper TEM Finder Grids*, 200 mesh.

7.40 *Carbon Evaporator Rods*.

7.41 *Lens Tissue*.

7.42 *Ashless Filter Paper Filters*, 90 mm diameter.

7.43 *Gummed Paper Reinforcement Rings*.

7.44 *Wash Bottles*, plastic.

7.45 *Reagent Alcohol*, HPLC Grade (Fisher A995 or equivalent).

7.46 *Opening Mesh Screen*, plastic, 1.0 by 1.0 mm, (Spectra-Mesh #146410 or equivalent).

7.47 *Diffraction Grating Replica*.

8. Sampling Procedure for Microvacuum Technique

8.1 For sampling asbestos-containing dust in either indoor or outdoor environments, commercially available cassettes must be used. Air monitoring cassettes containing 25 mm or 37 mm diameter mixed cellulose ester (MCE) or polycarbonate (PC) filter membranes with a pore size less than or equal to 0.8 µm are required (7.31). The number of samples collected depends upon the specific circumstances of the study.

8.2 Maintain a log of all pertinent sampling information and sampling locations.

8.3 Sampling pumps and flow indicators shall be calibrated using a certified standard apparatus or assembly (see Practice D 3195 and 7.29).

8.4 Record all calibration information **(5)**.

8.5 Perform a leak check of the sampling system at each sampling site by activating the pump (7.29) with the closed sampling cassette in line. Any air flow shows that a leak is present that must be eliminated before initiating the sampling operation.

[6] *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmaceutical Convention, Inc. (USPC), Rockville, MD.

[7] Tygon is a registered trademark of the DuPont Co.

8.6 Attach the sampling cassette to the sampling pump at the outlet side of the cassette with plastic tubing (7.35). The plastic tubing must be long enough in that the sample areas can be reached without interference from the sampling pump. Attach a clean, approximately 25.4 mm long piece of plastic tubing (6.35 mm internal diameter) directly to the inlet orifice. Use this piece of tubing as the sampling nozzle. Cut the sampling end of the tubing at a 45° angle as illustrated in Fig. 1. The exact design of the nozzle is not critical as long as some vacuum break is provided to avoid simply pushing the dust around on the surface with the nozzle rather than vacuuming it into the cassette. The internal diameter of the nozzle and flow rate of the pump may vary as long as the air velocity is 100 ($\pm$10) cm/s. This air velocity calculation is based on an internal sampling tube diameter of 6.35 mm at a flow rate of 2 L/min.

8.7 Measure and determine the sample area of interest. A sample area of 100 cm^2 is vacuumed until there is no visible dust or particulates matter remaining. Perform a minimum of two orthogonal passes on the surface within a minimum of 2 min of sampling time. Avoid scraping or abrading the surface being sampled. (Do not sample any debris or dust particles greater than 1 mm in diameter (see 4.2).) Smaller or larger areas can be sampled, if needed. For example, some surfaces of interest may have a smaller area than 100 cm^2. Less dusty surfaces may require vacuuming of larger areas. Unlike air samples, the overloading of the cassettes with dust will not be a problem. As defined in 3.2.5, only dust shall be collected for this analysis.

8.8 At the end of sample collection, invert the cassette so that the nozzle inlet faces up before shutting off the power to the pump. The nozzle is then sealed with a cassette end-plug and the cassette/nozzle taped or appropriately packaged to prevent separation of the nozzle and cassette assembly. A second option is the removal of the nozzle from the cassette, then plugging of the cassette and shipment of the nozzle (also plugged at both ends) sealed in a separate closeable plastic bag. A third option is placing the nozzle inside the cassette for shipment. The nozzle is always saved and rinsed because a significant percentage of the dust drawn from a lightly loaded surface may adhere to the inside walls of the tubing.

8.9 Check that all samples are clearly labeled, that all dust sampling information sheets are completed, and that all pertinent information has been enclosed, in accordance with laboratory quality control practices, before transfer of the samples to the laboratory. Include an unused cassette and nozzle as a field blank.

8.10 Wipe off the exterior surface of the cassettes with disposable wet towels (baby wipes) prior to packaging for shipment.

9. Sample Shipment

9.1 Ship dust samples to an analytical laboratory in a sealed container, but separate from any bulk or air samples. The cassettes must be tightly sealed and packed in a material free of fibers or dust to minimize the potential for contamination. Plastic "bubble pack" is probably the most appropriate material for this purpose.

10. Sample Preparation

10.1 Under a negative flow HEPA hood (7.5), carefully wet-wipe the exterior of the cassettes to remove any possible contamination before taking cassettes into a clean preparation area.

10.2 Perform sample preparation in a clean facility that has a separate work area from both the bulk and air sample preparation areas.

10.3 Initial specimen preparation shall take place in a clean HEPA filtered negative pressure hood to avoid any possible contamination of the laboratory or personnel, or both, by the potentially large number of asbestos structures in an asbestos-containing dust sample. Cleanliness of the preparation area hoods is measured by the cumulative process blank surface loadings (see Section 11).

10.4 All sample preparation steps 10.4.1-10.4.6 shall take place in the dust preparation area inside a HEPA hood.

10.4.1 Remove the upper plug from the sample cassette and carefully introduce approximately 10 mL solution of a 50/50 mixture of particle-free water and reagent alcohol into the cassette using a plastic wash bottle (7.44). If the plugged nozzle was left attached to the cassette, then remove the plug and introduce the water/alcohol solution into the cassette through the tubing, and then remove the tubing, if it is visibly clean.

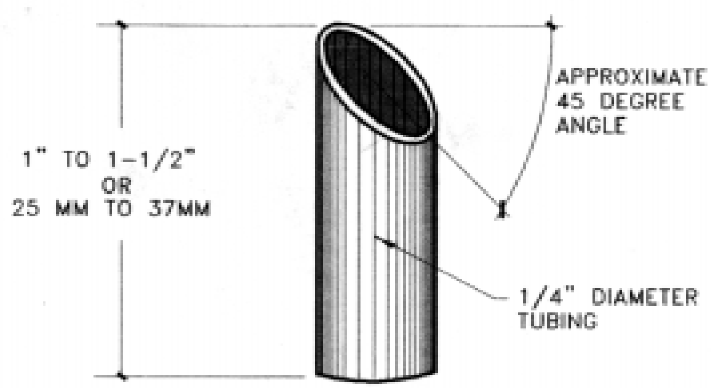

FIG. 1 Example of the Tubing Nozzle

10.4.2 Replace the upper plug or the sample cap and lightly shake the dust solution by hand for 3 s.

10.4.3 Remove the entire cap of the cassette and pour the suspension through a 1.0 by 1.0 mm opening screen (7.46) into a pre-cleaned 200 mL glass specimen bottle (7.9). All visible traces of the sample contained in the cassette shall be rinsed through the screen into the specimen bottle with a plastic wash bottle containing the 50/50 solution of particle-free water and alcohol. Repeat this procedure two additional times for a total of three washings. Next, rinse the nozzle two or three times through the screen into the specimen bottle with the 50/50 mixture of water and alcohol. Typically, the total amount of the 50/50 mixture used in the rinse is 50 to 75 mL. Discard the 1.0 by 1.0 mm screen and bring the volume of suspension in the specimen bottle up to the 100 mL mark on the side of the bottle with particle-free water only.

10.4.4 Adjust the pH of the suspension to 3 to 4 using a 10.0 % solution of acetic acid. Use pH paper for testing. Filter the suspension within 24 h to avoid problems associated with bacterial and fungal growth.

10.4.5 Use either a disposable plastic filtration unit or a glass filtering unit (7.14) for filtration of aliquots of the suspension. The ability of an individual filtration unit to produce a uniform distribution may be tested by the filtration of a colored particulate solution such as diluted India ink (solution of carbon black).

10.4.5.1 If a disposable plastic filtration unit is used, then unwrap a new disposable plastic filter funnel unit (either 25 or 47 mm diameter) and remove the tape around the base of the funnel. Remove the funnel and discard the top filter supplied with the apparatus, retaining the coarse polypropylene support pad in place. Assemble the unit with the adapter and a properly sized neoprene stopper, and attach the funnel to the 1000 mL side-arm vacuum flask (7.15). Place a 5.0 µ m pore size MCE (backing filter) on the support pad. Wet it with a few mL of particle-free water and place an MCE (7.16) or PC filter ($\leq$0.22 µm pore size) (7.17) on top of the backing filter. Apply a vacuum (7.36), ensuring that the filters are centered and pulled flat without air bubbles. Any irregularities on the filter surface requires the discard of that filter. After the filter has been seated properly, replace the funnel and reseal it with the tape. Return the flask to atmospheric pressure.

10.4.5.2 If a glass filtration unit is used, place a 5 µm pore size MCE (backing filter) on the glass frit surface. Wet the filter with particle-free water, and place an MCE or PC filter ($\leq$0.22 µm pore size) on top of the backing filter. Apply a vacuum, ensuring that the filters are centered and pulled flat without air bubbles. Replace the filters if any irregularities are seen on the filter surface. Before filtration of each set of sample aliquots, prepare a blank filter by filtration of 50 mL of particle-free water. If aliquots of the same sample are filtered in order of increasing surface loading, the glass filtration unit need not be washed between filtration. After completion of the filtration, do not allow the filtration funnel assembly to dry because contamination is then more difficult to remove. Wash any residual solution from the filtration assembly by holding it under a flow of water, then rub the surface with a clean paper towel soaked in a detergent solution. Repeat the cleaning operation, and then rinse two times in particle-free water.

10.4.6 With the flask at atmospheric pressure, add 20 mL of particle-free water into the funnel. Cover the filter funnel with its plastic cover if the disposable filtering unit is used.

10.4.7 Briefly hand shake (3 s) the capped bottle with the sample suspension, then place it in a tabletop ultrasonic bath (7.12) and sonicate for 3.0 min. Maintain the water level in the sonicator at the same height as the suspension in sample bottle. The ultrasonic bath shall be calibrated as described in 20.5. The ultrasonic bath must be operated at equilibrium temperature. After sonicating, return the sample bottle to the work surface of the HEPA hood. Preparation steps 10.4.8-10.4.14 shall be carried out in this hood.

10.4.8 Shake the suspension lightly by hand for 3 s, then let it rest for 2.0 min to allow large particles to settle to the bottom of the bottle or float to the surface.

10.4.9 Estimate the amount of liquid to be withdrawn to produce an adequate filter preparation. Experience has shown that a light staining of the filter surface will yield a suitable preparation for analysis. Filter at least 1.0 mL, but no more than half the total volume. If after examination in the TEM, the smallest volume measured (1.0 mL) (7.13) yields an overloaded sample, then perform additional serial dilutions of the suspension. If it is estimated that less than 1.0 mL of suspension has to be filtered because of the density of the suspension, perform a serial dilution.

10.4.9.1 If serial dilutions are required, repeat step 10.4.8 before the serial dilution portion is taken. Do not re-sonicate the original suspension or any serial dilutions. The recommended procedure for a serial dilution is to mix 10 mL of the sample suspension with 90 mL of particle-free water in a clean sample bottle to obtain a 1:10 serial dilution. Follow good laboratory practices when performing dilutions.

10.4.10 Insert a new disposable pipette halfway into the sample suspension and withdraw a portion. Avoid pipetting any of the large floating or settled particles. Uncover the filter funnel and dispense the mixture from the pipette into the water in the funnel.

10.4.11 Apply vacuum to the flask and draw the mixture through the filter.

10.4.12 Discard the pipette.

10.4.13 Disassemble the filtering unit and carefully remove the sample filter with fine tweezers (7.11). Place the completed sample filter particle side up, into a precleaned, labeled, disposable, plastic petri dish (7.48) or other similar container.

10.4.14 In order to ensure that an optimally-loaded filter is obtained, it is recommended that filters be prepared from several different aliquots of the dust suspension. For this series of filters, it is recommended that the volume of each aliquot of the original suspension be a factor of five higher than the previous one. If the filters are prepared in order of increasing aliquot volume, all of the filters for one sample can be prepared using one plastic disposable filtration unit, or without cleaning of glass filtration equipment between individual filtration. Before withdrawal of each aliquot from the sample, shake the suspension without additional sonification and allow to rest for 2 min.

10.4.15 There are many practical methods for drying MCE filters. The following are two examples that can be used: (*1*) dry MCE filters for at least 12 h (over desiccant) in an airtight cabinet-type desiccator (7.21); (*2*) to shorten the drying time (if desired), remove a plug of the damp filter and attach it to a glass slide (7.19) as described in 12.1.2 and 12.1.3. Place the slide with a filter plug or filter plugs (up to eight plugs can be attached to one slide) on a bed of desiccant, in the desiccator for 1 h.

10.4.16 PC filters do not require lengthy drying before preparation, but shall be placed in a desiccator for at least 30 min before preparation.

10.5 Prepare TEM specimens from small sections of each dried filter using the appropriate direct transfer preparation method.

11. Blanks

11.1 Prepare sample blanks that include both a process blank (50 mL of particle-free water) for each set of samples analyzed and one unused filter from each new box of sample filters (MCE or PC) used in the laboratory. If glass filtering units are used, prepare and analyze a process blank each time the filtering unit is cleaned. Blanks will be considered contaminated, if after analysis, they are shown to contain more than 53 asbestos structures per square millimetre. This generally corresponds to three or four asbestos structures found in ten grid openings. The source of the contamination must be found before any further analysis can be performed. Reject samples that were processed along with the contaminated blanks and prepare new samples after the source of the contamination is found.

11.2 Prepare field blanks which are included with sample sets in the same manner as the samples, to test for contamination during the sampling, shipping, handling, and preparation steps of the method.

12. TEM Specimen Preparation of Mixed Cellulose Ester (MCE) Filters

NOTE 1—Use of either the acetone or the diamethylformamide-acetic acid method is acceptable.

12.1 *Acetone Fusing Method*:

12.1.1 Remove a section (a plug) from any quadrant of the sample and blank filters. Sections can be removed from the filters using a 7 mm cork borer (7.32). The cork borer must be wet wiped after each time a section is removed.

12.1.2 Place the filter section (particle side up) on a clean microscope slide. Affix the filter section to the slide with a gummed page reinforcement (7.43), or other suitable means. Label the slide with a glass scribing tool or permanent marker (7.10).

12.1.3 Prepare a fusing dish from a glass petri dish (7.37) and a metal screen bridge (7.38) with a pad of five to six ashless paper filters (7.42) and place in the bottom of the petri dish **(4)**. Place the screen bridge on top of the pad and saturate the filter pads with acetone. Place the slide on top of the bridge in the petri dish and cover the dish. Wait approximately 5 min for the sample filter to fuse and clear.

12.2 *Dimethylformamide-Acetic Acid Method*:

12.2.1 Place a drop of clearing solution that consists of 35 % dimethylformamide (DMF), 15 % glacial acetic acid, and 50 % Type II water (v/v) on a clean microscope slide. Gauge the amount used so that the clearing solution just saturates the filter section.

12.2.2 Carefully lay the filter segment, sample surface upward, on top of the solution. Bring the filter and solution together at an angle of about 20° to help exclude air bubbles. Remove any excess clearing solution. Place the slide in an oven or on a hot plate, in a fume hood, at 65 to 70°C for 10 min.

12.3 Plasma etching of the collapsed filter is required.

12.3.1 The microscope slide to which the collapsed filter pieces are attached is placed in a plasma asher (7.27). Because plasma ashers vary greatly in their performance, both from unit to unit and between different positions in the asher chamber, it is difficult to specify the exact conditions that must be used. Insufficient etching will result in a failure to expose embedded fibers, and too much etching may result in the loss of particles from the filter surface. To determine the optimum time for ashing, place an unused 25 mm diameter MCE filter in the center of a glass microscope slide. Position the slide approximately in the center of the asher chamber. Close the chamber and evacuate to a pressure of approximately 40 Pa, while admitting oxygen to the chamber at a rate of 8 to 20 cm^3/min. Adjust the tuning of the system so that the intensity of the plasma is maximized. Determine the time required for complete oxidation of the filter. Adjust the system parameters to achieve complete oxidation of the filter in a period of approximately 15 min. For etching of collapsed filters, use these operating parameters for a period of 8 min. For additional information on calibration, see the *USEPA Asbestos-Containing Materials in Schools* **(4)** or *NIST/NVLAP Program Handbook for Airborne Asbestos Analysis* **(6)** documents.

12.3.2 Place the glass slide containing the collapsed filters into the low-temperature plasma asher, and etch the filter.

12.4 Carbon coating of the collapsed and etched filters is required.

12.4.1 Carbon coating must be performed with a high-vacuum coating unit (7.4), capable of less than 10^{-4} torr (13 MPa) pressure. Units that are based on evaporation of carbon filaments in a vacuum generated only by an oil rotary pump have not been evaluated for this application and shall not be used. Carbon rods (7.40) used for evaporators shall be sharpened with a carbon rod sharpener to a neck of about 4 mm in length and 1 mm in diameter. The rods are installed in the evaporator in such a manner that the points are approximately 100 to 120 mm from the surface of the microscope slide held in the rotating device.

12.4.2 Place the glass slide holding the filters on the rotation device, and evacuate the evaporator chamber to a vacuum of at least 13 MPa. Perform the evaporation in very short bursts, separated by 3 to 4 s to allow the electrodes to cool. An alternate method of evaporation is by using a slow continuous applied current. An experienced analyst can judge the thickness of the carbon film to be applied. Conduct tests on unused filters first. If the carbon film is too thin, large particles will be lost from the TEM specimen, and there will be few complete and undamaged grid openings on the specimen.

12.4.2.1 If the coating is too thick, it will lead to a TEM image that is lacking in contrast, and the ability to obtain electron diffraction patterns will be compromised. The carbon film shall be as thin as possible and still remain intact on most of the grid openings of the TEM specimen.

12.5 *Preparation of the Jaffe Washer*— The precise design of the Jaffe washer is not considered important, so any one of the published designs may be used **(7, 8)**. One such washer consists of a simple stainless steel bridge contained in a glass petri dish.

12.5.1 Place several pieces of lens tissue (7.41) on the stainless steel bridge. The pieces of lens tissue shall be large enough to completely drape over the bridge and into the solvent. In a fume hood, fill the petri dish with acetone (or DMF) until the height of the solvent is brought up to contact the underside of the metal bridge as illustrated in Fig. 2.

12.6 *Placing the Specimens into the Jaffe Washer*:

12.6.1 Place the TEM grids (7.39) shiny side up on a piece of lens tissue or filter paper so that individual grids can be easily picked up with tweezers.

12.6.2 Prepare three grids from each sample.

12.6.2.1 Using a curved scalpel blade (7.20), excise at least two square (3 mm by 3 mm) pieces of the carbon-coated MCE filter from the glass slide.

12.6.2.2 Place the square filter piece carbon-side up on top of a TEM specimen grid.

12.6.2.3 Place the whole assembly (filter/grid) on the saturated lens tissue in the Jaffe washer.

12.6.2.4 Place the three TEM grid sample filter preparations on the same piece of lens tissue in the Jaffe washer.

12.6.2.5 Place the lid on the Jaffe washer and allow the system to stand for several hours.

12.7 Alternately, place the grids on a low level (petri dish filled to the ⅛ mark) DMF Jaffe washer for 60 min. Add enough solution of equal parts DMF/acetone to fill the washer to the screen level. Remove the grids after 30 min if they have cleared, that is, all filter material has been removed from the carbon film, as determined by inspection in the TEM.

12.8 Carefully remove the grids from the Jaffe washer, allowing the grids to dry before placing them in a clean marked grid box.

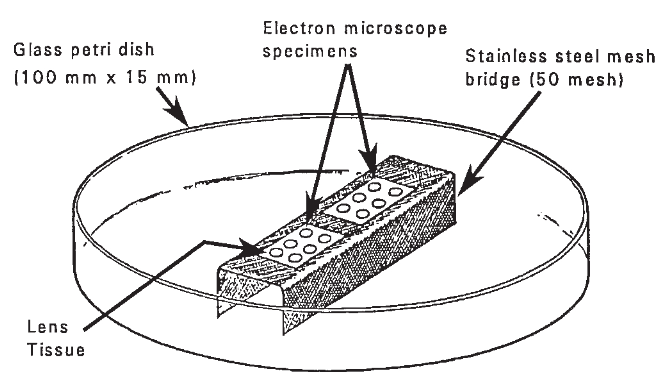

FIG. 2 Example of Design of Solvent Washer (Jaffe Washer)

13. TEM Specimen Preparation of Polycarbonate (PC) Filter

13.1 Cover the surface of a clean microscope slide with two strips of double-sided adhesive tape.

13.2 Cut a strip of filter paper slightly narrower than the width of the slide. Position the filter paper strip on the center of the length of the slide.

13.3 Using a clean, curved scalpel blade, cut a strip of the PC filter approximately 25 by 6 mm. Use a rocking motion of the scalpel blade to avoid tearing the filter. Place the PC strip particle side up on the slide perpendicular to the long axis of the slide. The ends of the PC strip must contact the double sided adhesive tape. Each slide can hold several PC strips. With a glass marker, label each PC strip with the individual sample number.

13.4 Carbon coat the PC filter strips as discussed in 12.4.2. PC filters do not require etching.

NOTE 2—**Caution:** Do not overheat the filter sections while carbon coating.

13.5 Prepare a Jaffe washer as described in 12.5, but fill the washer with chloroform or 1-methyl-2-pyrrolidone to the level of the screen.

13.6 Using a clean curved scalpel blade, excise three, 3-mm square filter pieces from each PC strip. Place the filter squares carbon side up on the shiny side of a TEM grid. Pick up the grid and filter section together and place them on the lens tissue in the Jaffe washer.

13.7 Place the lid on the Jaffe washer and rest the grids in place for at least 4 h. Best results are obtained with longer wicking times, up to 12 h.

13.8 Carefully remove the grids from the Jaffe washer, allowing the grids to dry before placing them in a clean, marked grid box.

14. Grid Opening Measurements

14.1 TEM grids must have a known grid opening area. Determine this area as follows:

14.2 Measure at least 20 grid openings in each of 20 random 75 to 100 µm (200-mesh) copper grids for a total of 400 grid openings for every 1000 grids used, by placing the 20 grids on a glass slide and examining them under the optical microscope. Use a calibrated graticule to measure the average length and width of the 20 openings from each of the individual grids. From the accumulated data, calculate the average grid opening area of the 400 openings.

14.3 Grid area measurements can also be made at the TEM at a calibrated screen magnification of between 15 000 and 20 000X. Typically measure one grid opening for each grid examined. Measure grid openings in both the x and y directions and calculate the area.

14.4 Pre-calibrated TEM grids are also acceptable for this test method.

15. TEM Method

15.1 Microscope settings: 80 to 120 kV, 15 000 to 20 000X screen magnification for analysis (7.2).

15.2 Analyze two grids for each sample. Analyze one-half of the sample area on one sample grid preparation and the remaining half on a second sample grid preparation.

15.3 *Determination of Specimen Suitability*:

15.3.1 Carefully load the TEM grid, carbon side facing up (in the TEM column) with the grid bars oriented parallel/perpendicular to the length of the specimen holder. Use a hand lens or loupe, if necessary. This procedure will line up the grid with the *x* and *y* translation directions of the microscope. Insert the specimen holder into the microscope.

15.3.2 Scan the entire grid at low magnification (250X to 1000X) to determine its suitability for high magnification analysis as specified in 15.3.3.

15.3.3 Grids are acceptable for analysis if the following conditions are met:

15.3.3.1 The fraction of grid openings covered by the replica section is at least 50 %.

15.3.3.2 Relative to that section of the grid covered by the carbon replica, the fraction of intact grid openings is greater than 50 %.

15.3.3.3 The fractional area of undissolved filter is less than 10 %.

15.3.3.4 The fraction of grid openings with overlapping or folded replica film is less than 50 %.

15.3.3.5 At least 20 grid openings, that have no overlapping or folded replica, are less than 5 % covered with holes and have less than 5 % opaque area due to incomplete filter dissolution.

15.4 *Determination of Grid Opening Suitability*:

15.4.1 If the grid meets acceptance criteria, choose a grid opening for analysis from various areas of the grid so that the entire grid is represented. Determine the suitability of each individual grid opening prior to the analysis.

15.4.2 The individual grid opening must have less than 5 % holes over its area.

15.4.3 Grid openings must be less than 25 % covered with particulate matter.

15.4.4 Grid openings must be uniformly loaded.

15.5 Observe and record the orientation of the grid at 80 to 150X, on a grid map record sheet along with the location of the grid openings that are examined for the analysis. If indexed grids are used, a grid map is not required, but the identifying coordinates of the grid square must be recorded.

16. Recording Data Rules

16.1 Record on the count sheet any continuous grouping of particles in which an asbestos fiber is detected. Classify asbestos structures as fibers, bundles, clusters, or matrices as defined in 5.2.

16.2 Use the criteria for fiber, bundle, cluster, and matrix identification, as described in the *USEPA Asbestos-Containing Materials in Schools* document **(4)**. Record, for each AHERA structure identified, the length and width measurements.

16.3 Record NSD (No Structures Detected) when no structures are detected in the grid opening.

16.4 Identify structures classified as chrysotile identified by either electron diffraction or X-ray analysis (7.3) and recorded on a count sheet. Verify at least one out of every ten chrysotile structures by X-ray analysis.

16.5 Structures classified as amphiboles by X-ray analysis and electron diffraction are recorded on the count sheet. For more information on identification, see Yamate, et al, **(7)** or Chatfield and Dillon **(8)**.

16.6 Record a typical electron diffraction pattern for each type of asbestos observed for each group of samples (or a minimum of every five samples) analyzed. Record the micrograph number on the count sheet. Record at least one X-ray spectrum for each type of asbestos observed per sample. Attach the print-outs to the back of the count sheet. If the X-ray spectrum is stored, record the file and disk number on the count sheet.

16.7 *Counting Rules*:

16.7.1 At a screen magnification of between 15 000 and 20 000X evaluate the grids for the most concentrated sample loading; reject the sample if it is estimated to contain more than 50 asbestos structures per grid opening. Proceed to the next lower concentrated sample until a set of grids are obtained that have less than 30 asbestos structures per grid opening.

16.8 *Analytical Sensitivity (AS)*—As determined by the following equation:

$$(EFA \times 100\ mL \times 1)/(GO \times GOA \times V \times SPL) = AS \quad (1)$$

where:

EFA	=	effective filter area of the final sampling filter, mm^2
GO	=	number of grid openings counted
GOA	=	average grid opening area, mm^2
SPL	=	surface area sampled, cm^2
V	=	volume of sample filtered in step 10.4.9, representing the actual volume taken from the original 100 mL suspension, mL
AS	=	analytical sensitivity, expressed as asbestos structures/cm^2

16.8.1 An AS of approximately 1000 asbestos structures per square centimetre (calculated for the detection of a single asbestos structure) has been designed for this analysis. This sensitivity can be achieved by increasing the amount of liquid filtered, increasing the number of grid openings analyzed, increasing the area of the collection, or decreasing the size of the final filter. For example, using a collection area = 500 cm^2, filter area = 1000 mm^2, number of grid openings = 10, and a grid area of 0.01 mm^2, V = 50 mL, the AS is 40 str/cm^2. Occasionally, due to high particle loadings or high asbestos surface loading, this AS cannot be practically achieved and stopping rules apply.

16.8.2 The numerical value of AS required for any specific application of this method may be achieved by selecting an appropriate combination of the sampling and analysis parameters in the above equation. For example, if SPL = 100 cm^2, EFA = 1000 mm^2, GO = 10, GOA = 0.01 mm^2, V = 10 mL, and D = 1, then AS = 1000 str/cm^2. Increasing GO to 50 and V to 50 mL changes the AS to 40 Str/cm^2.

16.8.3 When sample filters are heavily loaded with particulate matter, it may useful to employ serial dilutions during preparation to reduce the loading on grid specimens to acceptable levels and thus facilitate analysis. Under such circumstances, the AS may be calculated by substituting an appropriate value for the dilution factor, D, into the above equation. In general:

$$D = VA/(V + VPFW) \quad (2)$$

VA = the volume of the aliquot from the new, diluted suspension that is filtered to prepare the analytical filter; V = the volume of the aliquot from the initial (100 mL) suspension that is diluted; and VPFW = the volume of particle free water added to V during serial dilution to produce the new, diluted suspension.

Thus, if GO = 10, V = 10 mL, VPFW = 90 mL, and VA = 1.0 mL, D = 0.01 and the AS = 100 000 str/cm^2.

16.9 *Limit of Detection*—The limit of detection for this test method is calculated using the Practice D 6620. All data shall be provided in the laboratory report.

16.10 *Stopping Rules*:

16.10.1 The analysis is stopped upon the completion of the grid square that achieves an AS of less than 1000 asbestos structures per square centimetre.

16.10.2 If an AS of 1000 asbestos structures per square centimetre cannot be achieved after analyzing ten grid openings then stop on grid opening No. 10 or the grid opening which contains the 100th asbestos structure, whichever comes first. A minimum of four grid squares shall be analyzed for each sample.

16.10.2.1 If the analysis is stopped because of the 100th structure rule, the entire grid square containing the 100th structure must be counted.

16.11 After analysis, remove the grids from the TEM, and replace them in the appropriate grid storage holder.

17. Sample Storage

17.1 The washed-out sample cassettes can be discarded after use.

17.2 Sample grids and unused filter sections (7.18) must be stored for a minimum of one year.

18. Reporting

18.1 Report the following information for each dust sample analyzed:

18.1.1 Surface loading in structures/cm^2.

18.1.2 The AS.

18.1.3 Types of asbestos present.

18.1.4 Number of asbestos structures counted.

18.1.5 Effective filtration area.

18.1.6 Average size of the TEM grid openings that were counted.

18.1.7 Number of grid openings examined.

18.1.8 Sample dilution used.

18.1.9 Area of the surface sampled.

18.1.10 Listing of size data for each structure counted.

18.1.11 A copy of the TEM count sheet or a complete listing of the raw data. An example of a typical count sheet is shown in Appendix X1.

18.2 Determine the amount of asbestos in any accepted sample using the following formula:

$$\frac{EFA \times 100 \text{ mL} \times \#STR}{GO \times GOA \times V \times SPL} = \text{asbestos structures/cm}^2 \quad (3)$$

where:

#STR = number of asbestos structures counted,
EFA = effective filter area of the final sampling filter, mm^2,
GO = number of grid openings counted,
GOA = average grid opening area, mm^2,
SPL = surface area sampled, cm^2, and
V = volume of sample filtered in step 10.4.9, representing the actual volume taken from the original 100 mL suspension, mL.

19. Quality Control/Quality Assurance

19.1 In general, the laboratory's quality control checks are used to verify that a system is performing according to specifications regarding accuracy and consistency. In an analytical laboratory, spiked or known quantitative samples are normally used. However, due to the difficulties in preparing known quantitative asbestos samples, routine quality control testing focuses on re-analysis of samples (duplicate recounts).

19.1.1 Re-analyze samples at a rate of 1⁄10 of the sample sets (one out of every ten samples analyzed not including laboratory blanks). The re-analysis shall consist of a second sample preparation obtained from the final filter.

19.2 In addition, quality assurance programs must follow the criteria shown in the *USEPA Asbestos-Containing Materials in Schools* document **(4)** and in the *NIST/NVLAP Program Handbook for Airborne Asbestos Analysis* document **(6)**. These documents describe sample custody, sample preparation, blank checks for contamination, calibration, sample analysis, analyst qualifications, and technical facilities.

20. Calibrations

20.1 Perform calibrations of the instrumentation on a regular basis, and retain these records in the laboratory, in accordance with the laboratory's quality assurance program.

20.2 Record calibrations in a log book along with dates of calibration and the attached backup documentation.

20.3 A calibration list for the instrument is as follows:

20.3.1 *TEM*:

20.3.1.1 Check the alignment and the systems operation. Refer to the TEM manufacturer's operational manual for detailed instructions.

20.3.1.2 Calibrate the camera length of the TEM in electron diffraction (ED) operating mode before ED patterns of unknown samples are observed. Camera length can be measured by using a carbon coated grid on which a thin film of gold has been sputtered or evaporated. A thin film of gold is evaporated on the specimen TEM grid to obtain zone-axis ED patterns superimposed with a ring pattern from the polycrystalline gold film. In practice, it is desirable to optimize the thickness of the gold film so that only one or two sharp rings are obtained on the superimposed ED pattern. Thick gold films will tend to mask weak diffraction spots from the fibrous particles. Since the unknown d-spacings of most interest in asbestos analysis are those which lie closest to the transmitted beam, multiple gold rings from thick films are unnecessary. Alternatively, a gold standard specimen can be used to obtain an average camera constant calculated for that particular instrument and can then be used for ED patterns of unknowns taken during the corresponding period.

20.3.1.3 Perform magnification calibration at the fluorescent screen. This calibration must be performed at the magnification used for structure counting. Calibration is performed with a grating replica (7.47) (for example, one containing at least 2160 lines/mm).

(a) Define a field of view on the fluorescent screen. The field of view must be measurable or previously inscribed with a scale or concentric circles (all scales should be metric).

(b) Frequency of calibration will depend on the service history of the particular microscope.

(c) Check the calibration after any maintenance of the microscope that involves adjustment of the power supply to the lens or the high voltage system or the mechanical disassembly of the electron optical column (apart from filament exchange).

(d) The analyst must ensure that the grating replica is placed at the same distance from the objective lens as the specimen.

(e) For instruments that incorporate a eucentric tilting specimen stage, all specimens and the grating replica must be placed at the eucentric position.

20.3.1.4 The smallest spot size of the TEM must be checked.

(a) At the crossover point, photograph the spot size at a screen magnification of 15 000 to 20 000X. An exposure time of 1 s is usually adequate.

(b) The measured spot size must be less than or equal to 250 nm.

20.4 *EDXA*:

20.4.1 The resolution and calibration of the EDXA must be verified.

20.4.1.1 Collect a standard EDXA Cu peak from the Cu grid.

20.4.1.2 Compare the X-ray energy versus channel number for the Cu peak and be certain that readings are within ±10 eV.

20.4.2 Collect a standard EDXA of crocidolite asbestos (NIST SRM 1866).

20.4.2.1 The elemental analysis of the crocidolite must resolve the Na peak.

20.4.3 Collect a standard EDXA of chrysotile asbestos.

20.4.3.1 The elemental analysis of chrysotile must resolve both Si and Mg on a single chrysotile fiber.

20.5 Ultrasonic bath calibration shall be performed as follows:

20.5.1 Fill the bath water to a level equal to the height of suspension in the glass sample container that will be used for the dust analysis. Operate the bath until the water reaches the equilibrium temperature.

20.5.2 Place 100 mL of water (at approximately 20°C) in another 200-mL glass sample container, and record its temperature.

20.5.3 Place the sample container in the water in the ultrasonic bath (with the power turned off). After 60 s, remove the glass container and record its temperature.

20.5.4 Place 100 mL of water (at approximately 20°C) in another 200-mL glass sample container, and record its temperature.

20.5.5 Place the second sample container into the water in the ultrasonic bath (with the power turned on). After 60 s, remove the glass container and record its temperature.

20.5.6 Calculate the rate of energy deposition into the sample container using the following formula:

$$R = 4.185 \times \sigma \times \rho \times \frac{(\theta_2 - \theta_1)}{t} \quad (4)$$

where:

4.185 = Joules/cal,
R = energy deposition, watts/mL,
θ_1 = temperature rise with the ultrasonic bath not operating, °C,
θ_2 = temperature rise with the ultrasonic bath operating, °C,
t = time in seconds, 60 s (20.5.3 and 20.5.5),
σ = specific heat of the liquid in the glass sample container, 1.0 cal/g, and
ρ = density of the liquid in the glass sample container, 1.0 g/cm^3.

20.5.7 Adjust the operating conditions of the bath so that the rate of energy deposition is in the range of 0.08 to 0.12 MW/m^3, as defined by this procedure.

21. Precision and Bias

21.1 *Precision*—The precision of the procedure in this test method is being determined using round robin data from participating laboratories.

21.2 *Bias*—Since there is no accepted reference material suitable for determining the bias of the procedure in this test method, bias has not been determined (see Specification D 3670).

NOTE 3—Round robin data is under development and will be presented as a research report.

22. Keywords

22.1 asbestos; microvacuuming; settled dust; TEM

APPENDIX

(Nonmandatory Information)

X1. DUST SAMPLE ANALYSIS

X1.1 See Figs. X1.1 and X1.2 for the dust analysis worksheet and the TEM count sheet.

DUST SAMPLE ANALYSIS

Client:		Accelerating Voltage:	
Sample ID:		Indicated Mag:	KX
Job Number:		Screen Mag:	KX
Date Sample Analyzed:	- -	Microscope:	1 2 3 4 5
Number of Openings/Grids Counted:		Filter Type:	
Grid Accepted, 600X:	Yes No	Filter Size:	
Percent Loading:	%	Filter Pore Size (µm):	
Grid Box #1:		Grid Opening:	1) µm x µm
			2) µm x µm

Analyst:

Reviewer:

Counting Rules: AHERA LEVEL II

Calculation Data:

Effective Filter Area in mm^2:	(EFA)	
Number of Grid Openings Counted:	(GO)	
Average Grid Opening Area in mm^2:	(GOA)	
Volume of sample Filtered in ml:	(V)	
Surface area Sampled in cm^2:	(SPL)	
Number of Asbestos Structures Counted:*	(#STR)	

* If the number of asbestos structures counted is less than or equal to 4, enter 4 structures as the limit of detection here.

FORMULA FOR CALCULATION OF ASBESTOS STRUCTURES "DUST" PER CM^2:

$$\frac{EFA X 100 X \#STR}{GO X GOA X V X SPL} = \text{(Asbestos Structures per cm}^2\text{)}$$

Results for Total Asbestos Structures:

(Structures per cm^2)

Results for Structures ≥ microns:

(Structures per cm^2)

FIG. X1.1 Dust Sample Analysis Work Sheet

Job Number: ______________________________

Structure #	Grid # Square #	Type	Structure	Length Microns	Width Microns	Confirmation		
						Morph.	SAED	EDS

Note: Keys to Abbreviations Used in Figure:

Type:

C = Chrysotile
AM = Amosite
CR = Crocidolite
AC = Actinolite
TR = Tremolite
AN = Anthophyllite
N = Non Asbestos

Structure:

F = Fiber
B = Bundle
C = Cluster
M = Matrix

Others:

NSD = No Structures Detected
Morph = Morphology
SAED = Selected Area Electron Diffraction
EDS = Energy Dispersive X-Ray Spectroscopy
ER = Inter-Row Spacing
NP = No Pattern

FIG. X1.2 TEM Count Sheet

REFERENCES

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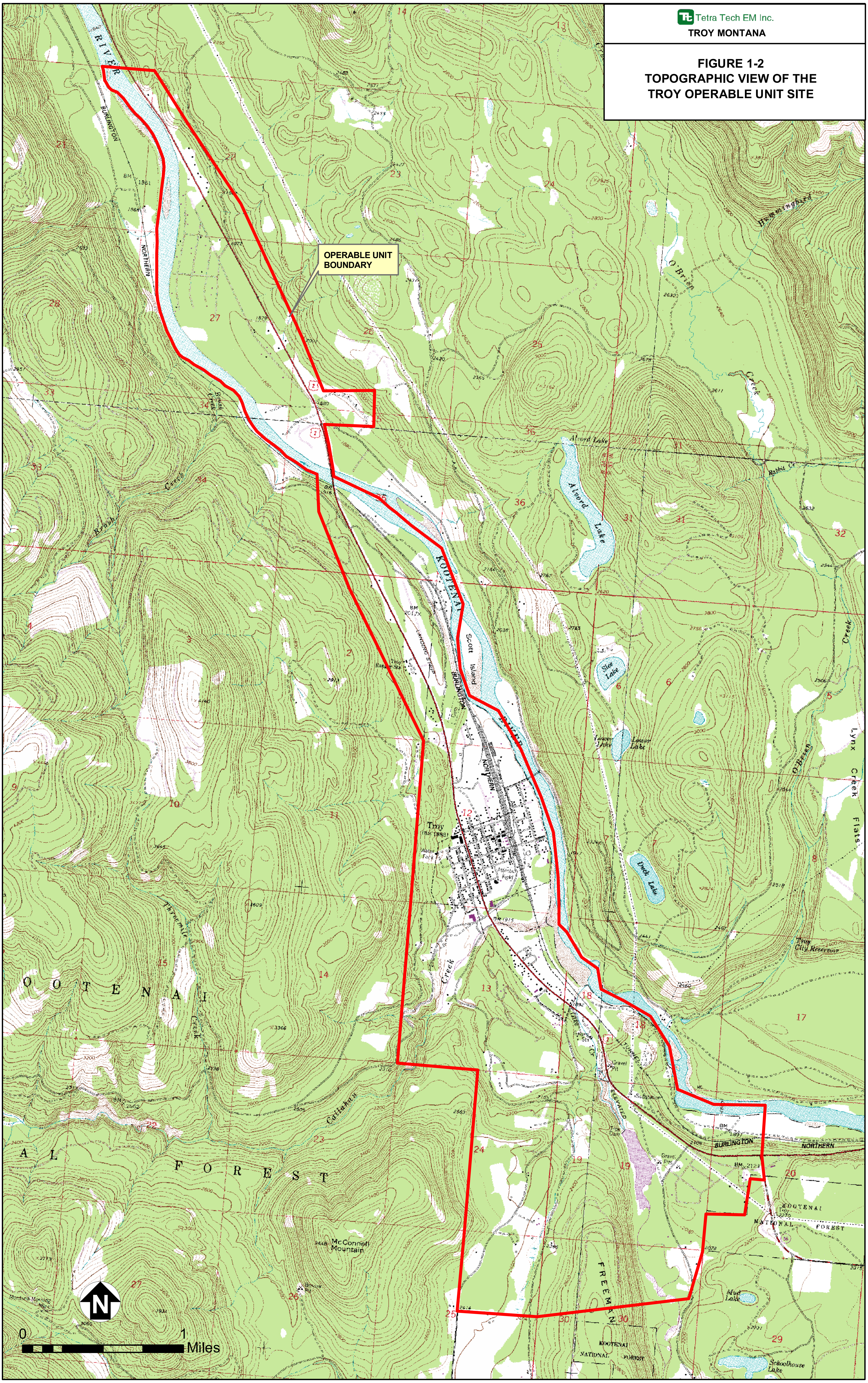
(**4**) " *USEPA Asbestos-Containing Materials in Schools: Final Rule and Notice," Federal Register*, 40 CFR Part 763, Appendix A to Sub-part E., Oct. 30, 1987.
(**5**) OSHA, *OSHA Technical Manual, OSHA Instruction CPL 2-20B*, Directorate of Technical Support, U.S. Department of Labor, Washington, DC 20210, Feb. 5, 1990, pp. 1–8 to 1–11.
(**6**) *NIST/NVLAP Program Handbook for Airborne Asbestos Analysis*, NISTIR, August 1989, pp. 89–4137.
(**7**) Yamate, G., Agarwall, S. C., and Gibbons, R. D., "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy," EPA Draft Report, Contract No. 68-02-3266, 1984.
(**8**) Chatfield, E. J., and Dillon, M. J., "Analytical Method for the Determination of Asbestos in Water," EPA No. 600/4-83-043, 1983.

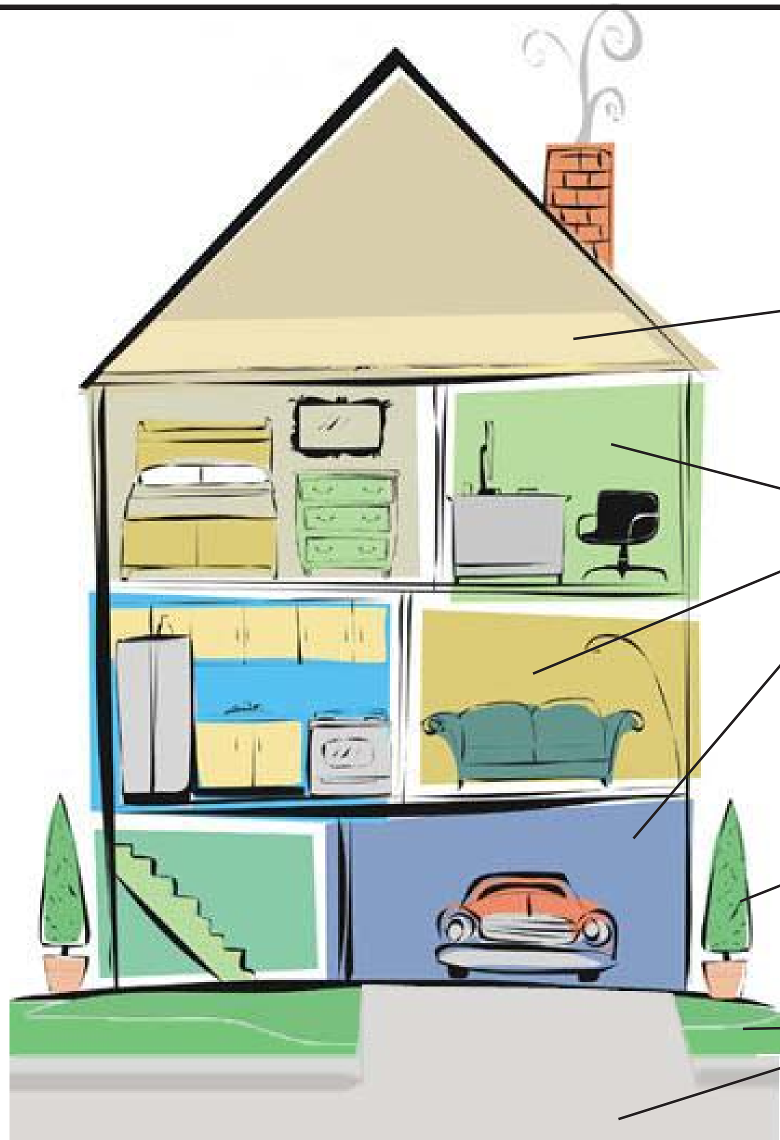
Tetra Tech EM Inc.

TROY MONTANA

FIGURE 1-2
TOPOGRAPHIC VIEW OF THE
TROY OPERABLE UNIT SITE



GIS map by Ed Madej TTEMI-HE
1-2_troy_basemap_study_area_010306.mxd



BUILDING INTERIOR

Inspect Building Attic for VCI

Inspect Each Building Level for VCI

SAMPLE COLLECTION

Complete field form
No sample collected in attic

If migrating VCI visible, sample room as SSVR

Collect dust samples from each building level

PROPERTY EXTERIOR

Specific Use Areas (gardens, flower beds, play areas; any areas with potentially greater exposure or greater use of amendments)

Inspect **each** Area and Collect Composite Soil Sample from **each** Area

Yards and Open Space

Inspect **all** Areas and Collect Composite Soil Sample from **each** Discrete Area of approximately 5,000 square feet.

NOTES:
VCI = Vermiculite Containing Insulation
SSVR = Small Scale Vermiculite Removal

TROY ASBESTOS PROPERTY EVALUATION
TROY, MONTANA

FIGURE 3-1
Tape Inputs

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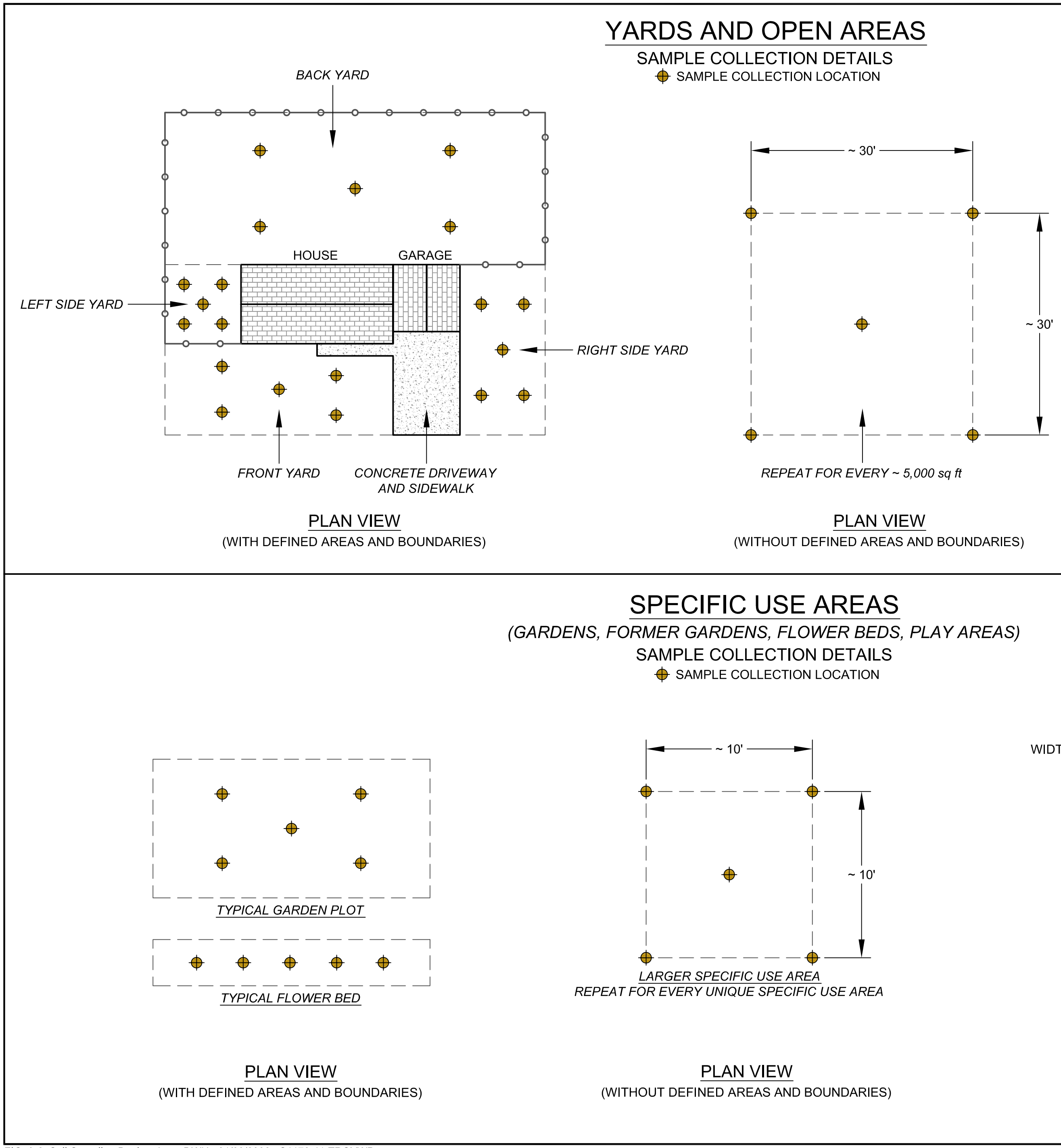
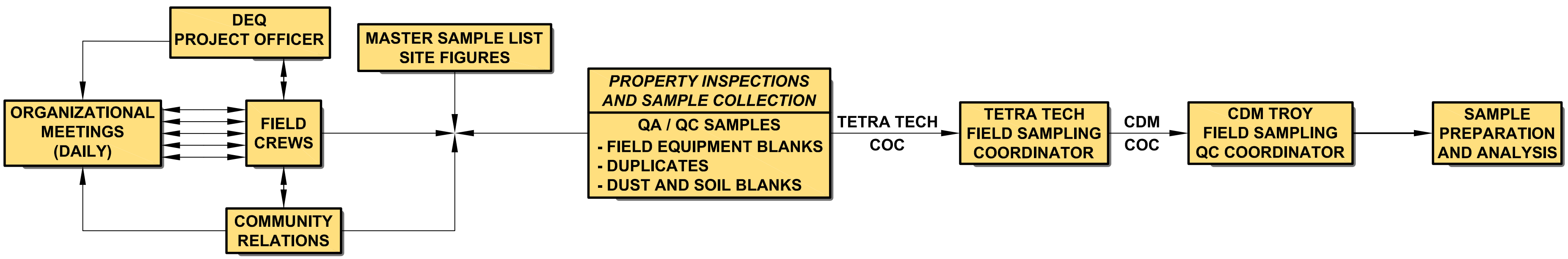


TROY ASBESTOS PROPERTY EVALUATION
TROY, MONTANA

FIGURE 3-2
TAPE Outdoor Soil Sampling Design

Tetra Tech EM Inc.

FIG_3-2_Soil Sampling Design.dwg - DWH - 01/03/2006 - S1176-41-TROYWP



DEQ - Montana Department of Environmental Quality

QA - Quality Assurance

QC - Quality Control

COC - Chain of Custody

TROY ASBESTOS PROPERTY EVALUATION
TROY, MONTANA

FIGURE 3-3
TAPE Inspection and Sampling Process Diagram

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Project Specific Guidance
Completion of Field Sample Data Sheets (FSDS)

Project: Libby Asbestos Remedial Investigation – Remedial Investigation (RI)

Project No.: 3282-137

Document No.: CDM-LIBBY-03 Revision 1

Prepared by: Dee A. Warren Date: 4/17/03

Approved by: ______________________________
Project Manager Date

____
Technical Reviewer Date

____
QA Reviewer Date

____
EPA Approval Date

A field sample data sheet (FSDS) must be completed using the following guidance.

Definitions:

Owner – (As it appears on the property IFF). Person who owns a residential property (may or may not be the current occupant), or the person who owns a commercial property.

Sample Coordinator – person responsible for the custody of all field paper work and samples collected

Soil Field Sample Data Sheet

Sheet No.: Pre-assigned unique sequential sheet number. Completed by sample coordinator.

Scenario No.: Scenario numbers are specific to the Phase II sampling program and do not apply to the RI. "NA" should be placed in this blank.

Field Logbook No.: The logbook number being used to record information specific to the samples on the FSDS.

Page No.: Page number in logbook on which information regarding the samples on the FSDS is recorded.

Sampling Date: Date samples are collected, in the form MM/DD/YY.

Address: (As it appears on the property IFF). The address of the property being sampled. Addresses are to be entered in the following format:

Street number – Direction – Street Name – Street Abbreviation

Where:
Street number = the number of the street address
Direction = the abbreviation of the street direction (N, S, E, or W), when applicable
Street name = correct spelling of the street name
Street abbreviation = when applicable

Road – Rd
Avenue – Ave
Street – St
Circle – Cr
Place – Pl
Boulevard – Blvd
Highway - Hwy

Examples: 510 N Mineral Ave
607 N Michigan Ave
521 Pipe Creek Rd

Business Name: (As it appears on the property IFF). If a business is located on the property, record the name. If a business is not located on the property, record NA.

Owner: (As it appears on the property IFF). Name of the property owner (not necessarily the current occupant).

Land Use: Description of land use on which property is located.

Sampling Team: Company affiliation of sampling team.

Names: Full name of all members of the sampling team.

Index ID: Sample identification (ID) number. Index ID numbers for the RI soil samples are in the form CS-#####. A set of available numbers is assigned to each sampling team by the sample coordinator.

Location ID: Unique identification number assigned to each sample location with a unique global positioning system (GPS) coordinate. For soil samples, location identifications (IDs) are in the form SP-#####. A set of available numbers is assigned to each sampling team by the sample coordinator.

Sample Group: The sample group for soil samples collected for the RI must be one of the following options:

Yard	Flower Bed
Garden	Field
Driveway	Walkway
Road	Park

Location Description: Description of the location where a soil sample was collected. If back yard, front yard, side yard, or driveway does not apply, use the other blank. If the yard sample was composed of sub-samples located in more than one yard location, circle all that apply.

Category: FS = field sample; FD = field duplicate; and FB = field blank. The field duplicate blank should be used to identify the FD of the parent FS.

Matrix Type: The samples collected for the RI will mostly be surface samples (0 to 1 or 0 to 6 inches). If a sample that is collected is not a surface sample, complete the other line using the following options: mining waste, subsurface soil, fill.

Type: Indicate the type of sample collected, grab or composite. If the sample is a composite sample, the number of sub-samples must be provided.

Time: The time of sample collection, in military time.

Top Depth: Top depth of sample in inches below the ground surface.

Bottom Depth: Bottom depth of sample in inches below the ground surface.

Field Comments: Any information specific to a sample. If vermiculite is present, this must be noted in the field comments section.

Entered: Completed by Volpe personnel at time of data entry.

Validated: Completed by Volpe personnel at time of data entry check.

Completed by: Initials of field team member that completes the FSDS.

QC by: Initials of field team member that completes QC check of FSDS.

Dust Field Sample Data Sheet

Sheet No.: Pre-assigned unique sequential sheet number. Completed by sample coordinator.

Scenario No.: Scenario numbers are specific to the Phase II sampling program and do not apply to the RI. "NA" should be placed in this blank.

Field Logbook No.: The logbook number being used to record information specific to the samples on the FSDS.

Page No.: Page number in logbook on which information regarding the samples on the FSDS is recorded.

Sampling Date: Date samples are collected, in the form MM/DD/YY.

Address: (As it appears on the property IFF). The address of the property being sampled. Addresses are to be entered in the following format:

Street number – Direction – Street Name – Street Abbreviation

Where:
Street number = the number of the street address
Direction = the abbreviation of the street direction (N, S, E, or W), when applicable
Street name = correct spelling of the street name
Street abbreviation = when applicable
Road – Rd
Avenue – Ave
Street – St
Circle – Cr
Place – Pl
Boulevard – Blvd
Highway - Hwy

Examples: 510 N Mineral Ave
607 N Michigan Ave
521 Pipe Creek Rd

Business Name: (As it appears on the property IFF). If a business is located on the property, record the name. If a business is not located on the property, record NA.

Owner: (As it appears on the property IFF). Name of the property owner (not necessarily the current occupant).

Land Use: Description of land use on which property is located.

Sampling Team: Company affiliation of sampling team.
Names: Full name of all members of the sampling team.

Index ID: Sample identification (ID) number. Index ID numbers for the RI dust samples are in the form 1-#####. A set of available numbers is assigned to each sampling team by the sample coordinator.

Location ID: Unique identification number assigned to each sample location with a unique global positioning system (GPS) coordinate. For dust samples, location identifications (IDs) are in the form BD-#####. The location ID for dust samples is the BD number of the structure the dust sample is collected in. A set of available numbers is assigned to each sampling team by the sample coordinator.

Matrix Type: Circle the structure type in which the sample is collected. If the best description of the structure is not an option, right a description in the blank provided.

Sample Group: Circle the floor/level the dust sample was collected on. If the best description of the floor/level is not an option, right a description in the blank provided.

Location Description: Circle the location the dust sample was collected per the dust sampling protocol. Circle all locations that apply to the sample. If the best description of the location is not an option, right a description in the blank provided.

Category: FS = field sample or blank. It the cassette was used to collect a sample, circle FS. If the cassette will be submitted as a blank, circle blank.

Sample Area: Circle the amount of area sampled with the cassette.

Filter Diameter: Circle the appropriate filter diameter.

Pore Size: Circle the appropriate pore size.

Flow Meter Type: Circle the type of flow meter used to calibrate the pump flow rate.

Flow Meter ID No.: Record the identification number of the flow meter used to calibrate the pump flow rate.

Pump ID No.: Record the identification number of the pump used to collect the sample.

Start Time: Record the starting time of each sample aliquot collection, in military time.

Start Flow: Record the starting pump flow rate for the sample colleted in Liters per minute (L/min).

Stop Time: Record the stopping time of each sample aliquot collection, in military time.

Stop Flow: Record the stopping pump flow rate for the sample colleted in minute L/min.
Pump Fault: If the pump faulted during sample collection, circle Yes. If the pump did not fault during sample collection, circle No.

Field Comments: For each 100cm2 aliquot locations, record the specific location sampled.

Entered: Completed by Volpe personnel at time of data entry.

Validated: Completed by Volpe personnel at time of data entry check.

Completed by: Initials of field team member that completes the FSDS.

QC by: Initials of field team member that completes QC check of FSDS.

Project Specific Guidance
Completion of Information Field Form (IFF)

Project: Libby Asbestos Remedial Investigation - Contaminant Screening Study (CSS)

Project No.: 3282-137

Document No.: CDM-LIBBY-04 Revision 1

Prepared by: Dee Warren 4/21/03
Project Scientist Date

Approved by: ____
Project Manager Date

____
Technical Reviewer Date

____
QA Reviewer Date

____
EPA Approval Date

An information field form (IFF) is to be completed for each structure located on a property. Three IFFs will be used: (1) primary structure and property assessment information field form (Primary IFF), (2) secondary structure information field form (Secondary IFF), and (3) primary structure and property assessment supplemental information field form (SIFF). The IFFs are completed from both interviews with the occupant/owner and visual inspection of the structures and surrounding properties and are used to facilitate the information-gathering process (interview and visual inspection) of properties during the contaminant screening study (CSS).

Definitions:

Primary structure – Refers to the main inhabitable structure on a property or the main commercial structure on a property.

Secondary structure – Refers to structures other than the primary structure located on a property (i.e., shed, barn, detached garage with an attic, etc.). Attached garages are considered part of the primary structure.

Occupant – Refers to the person currently living in a primary residential structure.

Owner – Refers to the person who owns a residential property (may or may not be the current occupant) or person who owns a commercial property.

Each entry on the IFF should be completed following the guidance procedure, and any notes on each item should be written in the notes column to the right of each data item. The IFF type the item refers to is shown following the description of the data to be entered.

Header Information

BD#: Refers to the location identification (ID) number of the structure the IFF is being completed for. The field team obtains a list of available numbers from the sample coordinator. The building number is the unique identification number of the building where the information was collected. For apartment buildings or commercial building with more than one occupant, an IFF will be completed for each occupant. The BD number placed on each IFF will be the BD number unique to that entire building. The apartment or suite number for which the IFF is being completed will be placed in the structure description field of the IFF. For trailer parks where there are multiple structures on the same property, each will be given a unique BD number and the lot number will be placed in the address (e.g., 576 Reese Ct #33). (Primary IFF, Secondary IFF, SIFF)

Phase I Background IFF (BIFF) No.: Refers to the BIFF number completed during phase I dust sampling. (SIFF)

Soil samples collected: Provide the date of CSS soil sample collection. This item is to be completed at the time of soil sample collection. (Primary IFF, Secondary IFF, SIFF)

Field Logbook No.: The number of the field logbook that is used to record information specific to the property being assessed on the IFF. (Primary IFF, Secondary IFF, SIFF)

Page No.: The page numbers in the logbook that contain information specific to the property being assessed on the IFF. (Primary IFF, Secondary IFF, SIFF)

Site Visit Date: Date of site visit, in the form MM/DD/YY. (Primary IFF, Secondary IFF, SIFF)

Address: The address of the property being assessed on the IFF. Addresses are to be entered in the following format detailed below. (Primary IFF, Secondary IFF, SIFF)

Street number – Direction – Street Name – Street Abbreviation

Where:

Street number = the number of the street address
Direction = the abbreviation of the street direction (N, S, E, or W), when applicable
Street name = correct spelling of the street name
Street abbreviation = when applicable

Road – Rd

Avenue – Ave
Street – St
Circle – Cr
Place – Pl
Boulevard – Blvd
Highway - Hwy

Examples: 510 N Mineral Ave
1616 Rainy Creek Rd
521 Pipe Creek Rd

Structure Description: Description of the structure specific to the IFF (i.e., house, trailer, garage, shed, barn). (Primary IFF, Secondary IFF, SIFF)

Occupant: Name of current occupants of the primary structure. In the case of a commercial property, the occupant information would not be completed. (Primary IFF, Secondary IFF, SIFF)

Occupant Phone Number: Phone number of occupant of the primary structure. (Primary IFF, Secondary IFF, SIFF)

Owner: Only needs to be completed if the owner of the structure or property is different than the current occupant (i.e., renter). Required for commercial properties. (Primary IFF, Secondary IFF, SIFF)

Owner Phone Number: Phone number of the owner of the property. For residential properties, only complete if the owner is different than the current occupant. Required for commercial properties. (Primary IFF, Secondary IFF, SIFF)

Business Name: Name of business located on property. (Primary IFF, Secondary IFF, SIFF)

Sampling Team: Full name and company of each member of the team assessing the property (i.e., members sampling and/or completing IFF). (Primary IFF, Secondary IFF, SIFF)

Field Form Check Completed by (100% of forms): To be signed, after IFF is checked by the field team member not completing the IFF. (Primary IFF, Secondary IFF, SIFF)

Screening Field check Completed by (2% of forms): To be signed, after IFF is checked by the CSS task leader. (Primary IFF, Secondary IFF, SIFF)

House Attributes

Property Description: Description of the property specific to the IFF being completed. Indicate all that apply. (Primary IFF, Secondary IFF)

Surrounding Land Use: Description of the land use groups surrounding the property specific to the IFF being completed. Indicate all that apply. (Primary IFF, Secondary IFF)

Year of Construction: Year structure was constructed. If occupant and/or owner do not know what year the structure was complete, choose unknown. (Primary IFF, Secondary IFF)

Square Footage: Calculated from the field diagram or estimated from occupant/owner interview. (Primary IFF, Secondary IFF)

Construction Material: Material structure is constructed from. If other than wood, masonry, or stone, choose other and provide a description. (Primary IFF, Secondary IFF)

Number of Floors Above Ground: Number of floors above ground specific to the structure that is assessed on the IFF. If other than 1, 2, or 3, provide number of floors in blank. The number of floors above ground should include the attic only if it is used as a living space. (Primary IFF, Secondary IFF)

Number of Rooms Per Floor Above Ground: Number of rooms per floor that is above ground. Enter number of rooms per floor next to the floor number. If more than three floors are present, provide the information on the blank. (Primary IFF, Secondary IFF)

Basement: If a basement is present, choose yes. If a basement is not present, choose no. Basement refers to a room below ground level that a person can enter and stand upright (i.e., a crawl space is not a basement). (Primary IFF, Secondary IFF)

Heating Source: Method by which heat is produced in the structure. If a method other than wood/coal, electric, or propane/gas is used as a heating source, choose other and provide a description. (Primary IFF, Secondary IFF)

Heat Distribution: Method by which heat is distributed throughout the structure. Occupant and/or owner should be able to provide this information. (Primary IFF, Secondary IFF)

Was the residence/building remodeled? Provide yes or no as an answer. If yes, provide years since remodeling and location of remodeling. If occupant/owner is unsure, provide a note in the provided space. (Primary IFF, Secondary IFF)

Has resident/business purchased any Libby vermiculite materials from W.R. Grace in the past? Based on occupant/owner interview. Provide yes or no as an answer. If occupant/owner is unsure, provide a note in the provided space. (Primary IFF)

Has the property at this location been used for a for-profit enterprise of distributing, treating, storing, or disposing of Libby vermiculite? Based on occupant/owner interview. Provide yes or no as an answer. If occupant/owner is unsure, provide a note in the provided space. (Primary IFF)

CSS Assessment

Occupant Information: Provide date verbal interview is completed. (Primary IFF, Secondary IFF, SIFF)

Is there any knowledge of former miners, close relatives of miners, or any highly exposed persons living or visiting the property? Circle the answer that applies based on the verbal interview. If the answer is unknown, state why in the comments section. (Primary IFF, Secondary IFF, SIFF)

Is the resident, past or present, diagnosed with an asbestos-related disease? Circle the answer that applies based on the verbal interview. If the answer is unknown, state why in the comments section. (Primary IFF, Secondary IFF, SIFF)

Indoor Information: Provide date indoor visual inspection was completed. (Primary IFF, Secondary IFF, SIFF)

Does the interior have vermiculite attic insulation? Circle the answer that applies based on the visual inspection. If the answer is unknown, state why in the comments section. (Primary IFF, Secondary IFF, SIFF)

Did the interior ever have vermiculite attic insulation? Circle the answer that applies based on the visual inspection and verbal interview. If the answer is unknown, state why in the comments section. NA applies if the attic currently has VCI. (Primary IFF, Secondary IFF, SIFF)

Are there vermiculite additives in any of the building materials? Circle the answer that applies based on the visual inspection and verbal interview. If vermiculite was used as an additive, provide the type of material and its location. If the answer is unknown, state why in the comments section. (Primary IFF, Secondary IFF, SIFF)

Location of indoor vermiculite: Circle all locations where indoor vermiculite was observed. If the best description of the location is not listed, provide a description in the space provided. If vermiculite is observed in the living space, circle the location (floor of structure) the vermiculite was observed on and provide the specific location in the area provided (i.e., first floor bathroom). (Primary IFF, Secondary IFF, SIFF)

Outdoor Information: Provide date outdoor visual inspection was completed. (Primary IFF, Secondary IFF, SIFF)

Location of outdoor vermiculite: Circle all locations where outdoor vermiculite was observed. If the best description of the location is not list, provide a description in the space provided. (Primary IFF, Secondary IFF, SIFF)

Overall Assessment: Provide date verbal interview, indoor visual inspection, outdoor visual inspection was completed. (Primary IFF, SIFF)

Are primary source materials present at the property? Circle the answer that applies based on the visual inspection and verbal interview. Vermiculite in secondary structures should be included in this answer. (Primary IFF, SIFF)

Where are primary source materials located? Circle the answer that applies based on the visual inspection and verbal interview. Vermiculite in secondary structures should be included in this answer. NA applies if no primary source materials are located at the property. (Primary IFF, SIFF)

Additional Information

Any information concerning the presence of sources that are identified in the occupant/owner interview and any partial access or sample collection issues. On Primary IFFs, indicate which secondary structures are present on the property and do not contain vermiculite. (Primary IFF, Secondary IFF, SIFF)

Field Diagram of Property

To include location of all important features (i.e., drainage, trees, structures, flowerbeds, utility poles, known underground utilities, suspected Libby amphibole source areas, sample locations, etc.). A north arrow and location of streets adjacent to the property should also be included. (Primary IFF, SIFF)

Site-Specific Standard Operating Procedure for Soil Sample Collection

SOP No: CDM-LIBBY-05 Revision 1

Project: Libby Asbestos Remedial Investigation – Contaminant Screening Study (CSS)/Remedial Investigation (RI)

Project Number: 3282-137

Prepared by:	Thomas E. Cook Environmental Scientist	4/3/02 Date
	Dee A. Warren, Revision 1 Project Scientist	4/17/03 Date
Approved by:	______________________ Project Manager	Date
	______________________ Technical Reviewer	Date
	______________________ QA Reviewer	Date
	______________________ EPA Approval	Date

Section 1
Purpose

The purpose of this standard operating procedure (SOP) is to provide a standardized method for surface soil sampling to be used by employees of EPA Region VIII contractors/subcontractors supporting EPA Region VIII CSS and RI activities for the Libby Asbestos Project in Libby, Montana. This SOP describes the equipment and operations used for sampling surface soils in residential areas, which will be submitted for the analysis of Libby amphiboles. The EPA Region VIII remedial project manager, or on-scene coordinator must approve site-specific deviations from the procedures outlined in this document prior to initiation of the sampling activity. This SOP provides the protocols for composite surface-soil sampling.

Section 2
Responsibilities

Successful execution of the sampling and analysis plan (SAP) requires a clear hierarchy of assigned roles with different sets of responsibilities associated with each role.

The CSS/RI task leader is responsible for overseeing the CSS/RI residential surface soil sampling activities. The CSS/RI task leader is also responsible for checking all work performed and verifying that the work satisfies the specific tasks outlined by this SOP and the SAP. It is the responsibility of the CSS/RI task leader to communicate with the field personnel specific collection objectives and anticipate situations that require any deviation from the SAP. It is also the responsibility of the CSS/RI task leader to communicate the need for any deviations from the SAP with the appropriate EPA Region VIII personnel (remedial project manager or on-scene coordinator).

Field personnel performing soil sampling are responsible for adhering to the applicable tasks outlined in this procedure while collecting samples at residences. The field personnel should have limited discretion with regard to collection procedures but should exercise judgment regarding the exact location of the sample point, within the boundaries outlined by the CSS/RI task leader.

Section 3
Equipment

- Sample container - The sample container will consist of quart-sized zip-top plastic bags (2 per sample).
- Trowel - For collecting surface soil samples.
- Bulb planter - For collecting surface soil samples.
- Shovel - For collecting surface soil samples.
- Stainless steel mixing bowl - Used to mix and homogenize composite soil samples after collection.
- Gloves - For personal protection and to prevent cross-contamination of samples. May be plastic or latex. Disposable, powderless.
- Field clothing and personal protective equipment (PPE) - As specified in the health and safety plan (HASP).
- Field sprayers - For decontaminating nondisposable sampling equipment between samples will be used.
- Silica sand - For field equipment blank quality control (QC) samples.
- Wipes - Disposable, paper. Used to clean and decontaminate sampling equipment.
- Field logbook -Used to record progress of sampling effort and record any problems and field observations.

- Information Field Forms (IFF) - Used to record information such as property detail, location of amphibole contamination, and estimated quantities.
- Field Sample Data Sheet (FSDS) - Used to record soil sample information.
- Permanent marking pen - Used to label sample containers.
- Index ID stickers - Used to label sample containers.
- Plastic buckets - Used to wash nondisposable field equipment between samples.
- Trash bag - Used to dispose gloves and wipes.
- Cooler - Used to store samples while in the field.
- Chain of Custody Record - For ensuring custody of samples until shipping.
- Custody Seals - For ensuring custody of samples during shipping.

Section 4
Sampling Pattern

Each property will be segregated into land use areas for sampling purposes. Use areas may include but not be limited to:

- Yard (grassy area)
- Landscaped area
- Garden
- Fill area
- Driveway

Properties with grassy areas greater than ½ acre in size will be sectioned off into separate zones for increased accuracy in characterization. Sectioning properties into additional zones will be at the discretion of the CDM field team leader but consistent among the teams. This segregation will be accomplished so that a five-point composite sample will characterize the section. A five-point composite sample will be collected for land areas less than or equal to 1/8 of an acre.

Up to five composite soil samples will be collected at each property. Composite sampling requires soil collection from multiple (sub-sample) points. Composite samples will be collected from similar land use areas (i.e., yard, garden, stockpiled soil, etc.). Additional composite or grab samples may be collected dependent upon site conditions (i.e., multiple land use areas, zones, etc.). Conversely, not all land areas previously mentioned will be applicable at every property and fewer (not less than two) will be collected.

For non-disturbed areas (i.e., yard), composite samples will be collected from 0 to 1 inch (in.). For disturbed areas (i.e., driveway garden, fill area, landscaped areas, etc.), composite samples will be collected from 0 to 6 in. All composite soils samples will have five subsamples (i.e., five-point composite sample) of approximately equal size.

If vermiculite is observed in large land use areas (driveway and yards), one sample should be collected from each area. Any other land use areas where vermiculite product is visible will not be sampled. Instead, the location will be recorded in the field logbook and on the IFF.

Section 5
Sample Collection

Don the appropriate PPE as specified in the HASP. A new pair of plastic gloves are to be worn for each sample collected. Segregate land use areas on the property as described in Section 4. Visually inspect each land use area for visual vermiculite product. To reduce dust generation during sampling, use a sprayer with deionized water to wet each sample point prior to collection. Use the trowel to check beneath the surface soil layer, but do not advance more than 6 in. If visible vermiculite is observed, record information in the appropriate field forms and do not collect a sample from that land use area. If visible vermiculite is not observed, proceed with sample collection.

Within each land use area, select five subsample locations equidistant from each other. These five subsample locations will comprise the five-point composite sample for that land use area. All composite subsamples will originate from the same land use area. For example, do not mix subsamples from garden areas with subsamples from grassy areas.

Clean the subsample locations of twigs, leaves, and other vegetative material that can be easily removed by hand. Using the trowel, excavate a hole in the soil approximately 2 in. in diameter and 1 in. deep (6 in. for disturbed areas) while placing the excavated material directly inside the mixing bowl. The sides of the excavated hole should be close to vertical to avoid sampling that is biased in favor of the upper layer of soil. Repeat this step for each subsequent subsample until the appropriate number of composite subsamples has been collected.

Homogenize the sample using the sampling trowel. Once the sample is homogenized, fill the zip-top plastic bag to 1/3rd full (approximately 2000 grams). Affix the sample index identification (ID) sticker to the inside of the bag and write the index ID number on the outside of the bag. Double bag the sample and repeat the labeling process for the outer bag. Decontaminate equipment between composite samples as described in Section 8.

Repeat steps outlined above until all samples from a property have been collected.

Soil field duplicate samples will be collected at a rate of 1 per 20 (5 percent) of the field samples. Field duplicate samples will be collected as samples co-located in the same land use area. The duplicate will be collected from the same number of subsamples as the parent sample, but the subsample locations of the duplicate sample will be randomly located in the use area. These samples will be independently collected with separate sampling equipment. These samples will be used to determine the variability of sample results in a given land use are. These samples will not be used to determine variability in sampling techniques.

Section 6
Site Cleanup

Specific instruction regarding site cleanup of investigation-derived waste (IDW) is included in CDM SOP 2-2, Guide to Handling Investigation-Derived Waste, with modification. In general, replace soil plug with excess sample volume. The soil should be placed back into the hole and tamped down lightly. If sandy areas such as playgrounds are sampled, refilling the soil plug is not necessary.

Rinse water, the roots of vegetation removed during sampling, and any excess soil volume may be disposed of on the ground as specified in the SAP.

Section 7
Record Keeping and Quality Control

A field logbook should be maintained by each individual or team that is collecting samples as described in the SAP. The SAP will detail specific conditions (SOP 4-1), which require attention, but at a minimum the following information should be collected:

- Date
- Time
- Team members
- Weather conditions
- PPE used
- Locations of any samples and subsamples that could not be acquired
- Descriptions of any deviations to the SAP and the reason for the deviation

Complete the IFF and FSDS for each property/sample.

Quality control samples will include:

- Field duplicates
- Equipment blank samples

Detailed information on QC sample collection and frequency is included in the SAP.

Section 8 Decontamination

All sampling equipment must be decontaminated prior to reuse. Specific instructions on sample equipment decontamination are included in CDM SOP 4-5, Field Equipment Decontamination at Nonradioactive Sites, with modification. In general, the procedure to decontaminate all equipment is outlined below:

Decontamination procedures for soil sampling equipment will follow these steps:

- Remove all gross contamination with plastic brush
- Use DI water and a plastic brush to wash each piece of equipment
- Remove excess water present on the equipment by shaking
- Use a paper towel to dry each piece of equipment
- Wrap dried equipment in aluminum foil

Once a week all soil sampling equipment will be cleaning using Alconox and DI water.

Spent wipes, gloves, and PPE must be disposed or stored properly as specified in the SAP.

Section 9 Glossary

Sampling and Analysis Plan (SAP) - The written document that spells out the detailed site-specific procedures to be followed by the project leader and the field personnel.

Sample Point - The actual location at which the sample is taken. The dimension of a sample point is 2 in. across by 1 in. deep (6 in. for disturbed areas).

Composite Sampling - A sample program in which multiple sample points are compiled together and submitted for analysis as a single sample.

Land Use Area - A section of property segregated by how the property owner uses the section. For example, garden landscaped areas are individual land use areas. Grassy areas (i.e., lawn) are also considered to be a separate land use area.

Health and Safety Plan

For

Troy Asbestos Property Evaluation (TAPE)

HEALTH AND SAFETY PLAN

Troy Asbestos Property Evaluation

Contract No.	:	DEQ 402014-TO41
	:	
Date Prepared	:	12/30/05
Prepared by	:	Tetra Tech EM Inc. (Tetra Tech)
Tech Project Manager	:	J. Edward Surbrugg, Ph.D.
Telephone No.	:	(406) 442-5588

REVIEWS AND APPROVALS

CLIENT NAME:
CONTRACT NO.:

We the undersigned have read and approve of the health and safety guidelines presented in this health and safety plan for on-site work activities for the Troy Asbestos Property Evaluation project.

Name	Signature	Date
Glynis Foulk Tetra Tech EM Inc. (Tetra Tech) Health and Safety Representative (916) 853-4561		
J. Edward Surbrugg, Ph.D. Tetra Tech Project Manager	______________________	____________

This certifies that Tetra Tech has assessed the type, risk level, and severity of hazards for the project and has selected appropriate personal protective equipment for site personnel in accordance with Occupational Safety and Health Administration Title 29 of the *Code of Federal Regulations*, Part 1910.132.

Certified by

Glynis Foulk Tetra Tech Technical Reviewer	______________________	____________

EMERGENCY INFORMATION
EMERGENCY CONTACTS AND ROUTE TO HOSPITAL

Emergency Contact	**Telephone No.**
U.S. Coast Guard National Response Center	(800) 424-8802
Montana Department of Emergency Services	(406) 431-0411
InfoTrac Chemical Monitoring System	(800) 535-5053
Fire Department	911
Police Department	911
Tetra Tech EM Inc. Personnel:	
Human Resource Development:	
Health and Safety Representative: Glynis Foulk	(678) 775-3094
Office Health and Safety Coordinator: Sandra Hertweck	(406) 442-5588, ext. 221
Project Manager: J. Edward Surbrugg	(406) 442-5588, ext. 230
Site Safety Coordinator: Mark Stockwell	(208) 263-4524
Client Contact: Catherine LeCours	(406) 841-5040
Client Title: Montana DEQ Project Officer	

Medical Emergency		
Hospital Name:	St. John's Lutheran Hospital	
Hospital Address:	350 Louisiana Avenue Libby, MT 59923	
Hospital Telephone No.:	General – 406-293-0100	Emergency – 911
Ambulance Telephone No.:		911

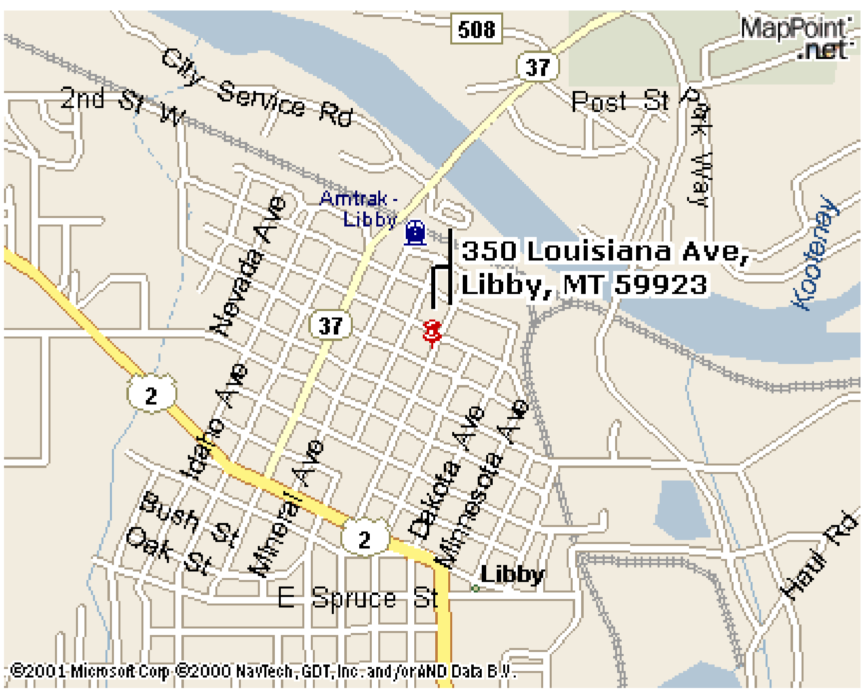
Route to Hospital: (see next page, hospital route map)

1. Routes will differ from each sample site

Note: This sheet must be posted on site.

EMERGENCY INFORMATION

HOSPITAL ROUTE MAP



Note: This sheet must be posted on site.

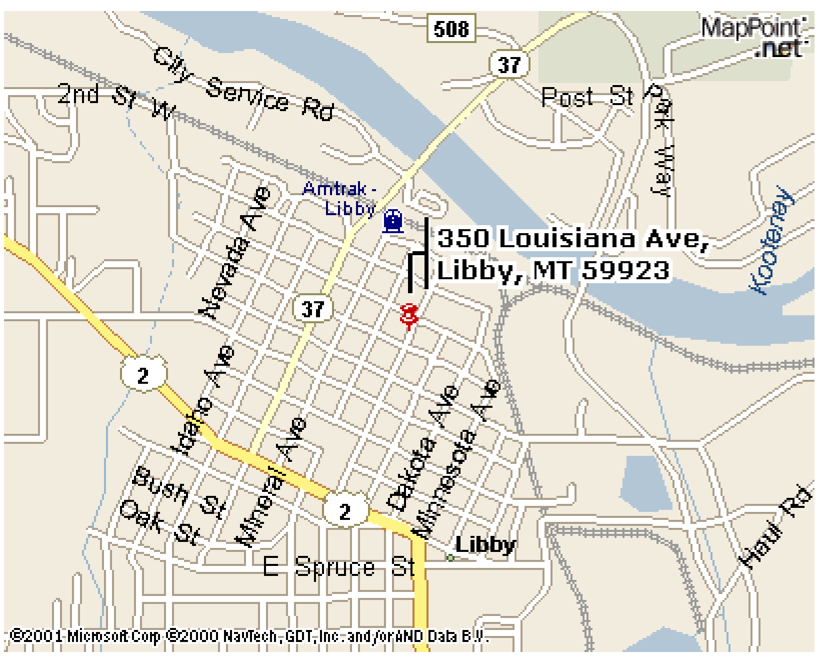
EMERGENCY INFORMATION

EMERGENCY CONTACTS AND ROUTE TO HOSPITAL

Medical Emergency (secondary – use for major emergency only)	
Hospital Name:	St. John's Lutheran Hospital
Hospital Address:	350 Louisiana Avenue, Libby, MT 59923
Hospital Telephone No.:	Emergency – 911 or General – 406-293-0100
Ambulance Telephone No.:	911
Route to Hospital: (see next page hospital route map) 1. Routes will differ from each sample site	

EMERGENCY INFORMATION

HOSPITAL ROUTE MAP



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CONTENTS (Continued)

FIGURES

TABLES

1.0 INTRODUCTION

This document addresses items specified under Occupational Safety and Health Administration (OSHA) Title 29 of the *Code of Federal Regulations* (CFR), Part 1910.120 (b), "Final Rule." This health and safety plan (HASP) will be available to all on-site personnel who may be exposed to hazardous on-site conditions, including Tetra Tech and subcontractor personnel, and all site visitors, including regulatory agency representatives. The site-specific health and safety provisions in this document have been developed for use during the TAPE and sampling activities

The purpose of this HASP is to define requirements and designate protocols to be followed during the Troy Asbestos Property Evaluation (TAPE) inspection and sampling activities. All personnel on site, including Tetra Tech and subcontractor employees and site visitors, must be informed of site emergency response procedures and any potential health, or safety hazards associated with on-site activities. This HASP summarizes potential hazards and defines protective measures planned for site activities.

This plan must be reviewed and approved by the Tetra Tech health and safety representative (HSR) or a designee and the Tetra Tech project manager (see the Reviews and Approvals form after the Contents in this document). The Compliance Agreement form in Appendix A must be signed by all personnel before they enter the site. Protocols established in this HASP are based on site conditions and health and safety hazards known or anticipated to be present and on available site data. This plan is intended solely for use during proposed activities described in the corresponding site-specific work plan. Specifications herein are subject to review and revision based on actual conditions encountered in the field during site activities. Significant revisions to this plan must be approved by the Tetra Tech project manager and the Tetra Tech HSR. Tetra Tech employees must also follow safety requirements taught during safety training and described in the Tetra Tech, Inc., "Health and Safety Manual."

2.0 HEALTH AND SAFETY PLAN ENFORCEMENT AND PERSONNEL

This section describes responsibilities of project personnel, summarizes requirements for subcontractors and visitors who wish to enter the site during survey and sampling activities, and discusses HASP enforcement.

2.1 PROJECT PERSONNEL

The following personnel and organizations are associated with planned activities at the site. The organizational structure will be reviewed and updated as necessary during the course of the project.

Name/Title	Responsibility	Telephone No.
Client Representative:		
Ms. Catherine LeCours	Montana DEQ Representative	(406) 841-5040
Tetra Tech Personnel:		
J. Edward Surbrugg	TAPE Project Manager	(406) 442-5588 x 230
Brian Antonioli	Contract Manager	(406) 442-5588 x 235
Mark Stockwell	Site Safety Coordinator (SSC)	(208) 263-4524
Mark Stockwell	Field Team Leader	(208) 263-4524

The Tetra Tech project manager, contract manager, SSC, and Field Team Leader will be responsible for implementation and enforcement of the provisions of this HASP including completion of all applicable forms included as appendices to this health and safety plan. Their duties and the expectations for Tetra Tech employees are described in the following sections.

2.1.1 Project Manager and Field Manager

The Tetra Tech project manager has ultimate responsibility for implementing the requirements set forth in this HASP. Some of this responsibility may be achieved through delegation to site-dedicated personnel who report directly to the project manager. The project manager shall regularly confer with site personnel regarding safety and health compliance.

The Tetra Tech field team leader will oversee and direct field activities and has day-to-day responsibility for implementing the HASP. The field manager will report directly to the project manager any health and safety-related issues.

2.1.2 Site Safety Coordinator

The Tetra Tech SSC will be appointed by the project manager and will be responsible for field implementation of tasks and procedures contained in this HASP, including air monitoring, establishing a decontamination protocol, and overseeing the signing of the Daily Tailgate Safety Meeting form (Form HST-2) and the Compliance Agreement (Form HSP-4) (see Appendix A) by all personnel working on site. The SSC will have advanced field work experience and be familiar with health and safety requirements specific to the project. The SSC will also maintain the Daily Site Log (Form SSC-1 in Appendix A).

2.1.3 Health and Safety Representative

The Tetra Tech HSR is responsible for administration of the company health and safety program. The HSR will act in an advisory capacity to project managers and site personnel for project-specific health and safety issues.

2.1.4 Tetra Tech Employees

Tetra Tech employees are expected to fully participate in implementing the site HASP by obtaining necessary training, attending site safety meetings, always wearing designated personal protective equipment (PPE), complying with site safety and health rules, and advising the Tetra Tech SSC of health and safety concerns at the site.

2.2 SUBCONTRACTORS

Subcontractors will follow and adhere to the same guidelines as stated in Section 2.1.4

2.3 VISITORS

All site visitors will be required to read the HASP and sign the Compliance Agreement form (see Appendix A). Visitors will be expected to comply with relevant OSHA requirements. Visitors will also be expected to provide their own PPE required by the HASP. Visitors who have not met OSHA training, medical surveillance, and PPE requirements are not permitted to enter areas where exposure to hazardous materials is possible.

2.4 HEALTH AND SAFETY PLAN ENFORCEMENT

This HASP applies to all site activities and all personnel working on the TAPE project. HASP enforcement shall be rigorous. Violators of the HASP will be verbally notified upon first violation, and the violation will be noted by the Tetra Tech SSC in a field logbook. Upon second violation, the violator will be notified in writing, and the Tetra Tech project manager and the violator's supervisor will be notified. A third violation will result in a written notification and violator's eviction from the site. The written notification will be sent to human resources development and the HSR.

Personnel will be encouraged to report to the SSC any conditions or practices that they consider to be detrimental to their health or safety or believe are in violation of applicable health and safety standards. Such reports may be made orally or in writing. Personnel who believe that an imminent danger threatens human health or the environment are obligated to remove themselves from the area or the hazardous condition and warn all other personnel of the source of the danger. The hazardous condition or matter will be brought to the immediate attention of the SSC for resolution.

At least one copy of this HASP will be available to all site personnel at all times. Minor changes in HASP procedures will be discussed at the beginning of each workday by the SSC at the daily tailgate safety meeting. Significant plan revisions must be discussed with the HSR and project manager.

3.0 SITE BACKGROUND

The TAPE inspection and sampling project will include collecting dust and soil samples from private and public property to evaluate the magnitude and extent of asbestos contamination and develop viable remedial alternatives. The following sections describe the TAPE site, its history, and activities planned for this project. The location of Troy, Montana can be found in Figure 1.

FIGURE 1 – SITE LOCATION

3.1 SITE DESCRIPTION

Troy, Montana, is located 18 miles from Libby, Montana. Through 1990, Libby, Montana contained a vermiculite mine and associated processing operations that produced a large amount of the world's supply of vermiculite. The vermiculite deposit is contaminated with a virulent form of amphibole asbestos (Libby amphibole). Asbestos is a known carcinogen and is associated with a multitude of respiratory health effects including asbestosis, lung cancer, and mesothelioma. For decades, while the mine operated and after its closure, contaminated vermiculite and waste materials were ubiquitous in the community. Many of the mine workers lived in Troy and commuted to the mine to work because Troy is close to Libby. Workers were exposed to contaminated materials at the mine and processing facilities; they transported contaminated dust to their homes on clothes and equipment; and vermiculite and contaminated waste rock in varying forms was used in soils (e.g. as fill or an amendment), construction materials, and for insulation all around the town.

In 1999, EPA Region 8 dispatched an emergency response team to investigate in response to media reports that described a high rate of asbestos related deaths in Libby. Originally believed to be a problem limited to the mine workers, the scope has increased. Subsequent environmental investigations have found many areas in Libby with LA contamination. EPA began Superfund emergency response removal actions in Libby in 2000 that are ongoing through 2005. Properties in Troy are being investigated to determine if LA-contaminated vermiculite has been transported to these sites and at concentrations that would pose health risks to the occupants.

3.2 PLANNED ACTIVITIES

Activities to be performed during the TAPE include the following…

Indoor Inspections: The two-person sampling team will visually inspect each structure for the presence of vermiculite-containing insulation (VCI).

Indoor dust sampling: Dust samples will be collected using microvac sampling techniques in all primary and secondary structures.

Outdoor Inspection: All areas of a property that are not covered with structures or special use areas shall be inspected for vermiculite product in soil and surfacing materials.

Outdoor Soil Sampling: After conducting the visual inspection of the property, the sampling team will collect soil samples.

These tasks are described in detailed in Section 4 of the TAPE work plan.

4.0 EVALUATION OF SITE-SPECIFIC HAZARDS

Field activities and physical features of the site may expose field personnel to a variety of hazards. This section provides information on potential hazards related to site activities and the nature of hazardous material effects.

4.1 CHEMICAL HAZARDS

Tremolite-actinolite asbestos is the only potentially hazardous substance anticipated to be encountered during site activities. Potential routes of exposure, exposure limits, and the toxic characteristics of asbestos are listed in Table 4-1. The primary route of exposure is inhalation; however, secondary potential routes of exposure include dermal (skin) contact and ingestion. Asbestos may also contaminate equipment, vehicles, instruments, and personnel. The overall health threat from exposure to asbestos is uncertain because (1) actual concentrations that personnel could be exposed to cannot be predicted, (2) the actual duration of exposure is unknown, and (3) the effects of low-level exposure to a mixture of chemicals and/or asbestos cannot be predicted. However, Tetra Tech believes that the potential for high-level exposure is limited.

Specific information on potential chemical hazards at the site is provided in Table 4-1. Table 4-2 provides a task hazard analysis of the planned activities listed in Section 3.2.

No potentially hazardous materials will be brought to the site by Tetra Tech during the completion of the field activities. Because of the nature of asbestos sampling, all PPE and monitoring equipment can be decontaminated using soap and water. Calibration of air monitoring equipment to be used during the completion of this project will be performed without the use of hazardous materials.

TABLE 4-1

POTENTIAL CHEMICAL HAZARDS
TAPE INSPECTION AND SAMPLING PROJECT

Chemical	Exposure Limits and IDLH Level	Exposure Routes	Toxic Characteristics
Asbestos	OSHA PEL: 0.1 fiber/cm^3 (8 hour TWA) ACGIH TLV: 0.1 fiber/cm^3 IDLH: Not Established	Inhalation (primary), ingestion, skin and/or eye contact	Asbestosis, lung cancer, mesothelioma

Notes:

ACGIH American Conference of Governmental Industrial Hygienists
IDLH Immediately dangerous to life or health
cm^3 Cubic centimeter
OSHA Occupational Safety and Health Administration
PEL Permissible exposure limit
ppm Part per million
TLV Threshold limit value
TWA Time weighted average

Sources: ACGIH. "Threshold Limit Values and Biological Exposure Indices for 1998." Latest edition.

National Institute for Occupational Safety and Health. 1997. "Pocket Guide to Chemical Hazards." U.S. Department of Health and Human Services. U.S. Government Printing Office. Washington, DC. June.

TABLE 4-2

TASK HAZARD ANALYSIS
TAPE Inspection and Sampling Project

Task	Potential Hazard	Controls	Initial Level of Protection	Upgraded Level of Protection
Task 1 – Interior Attic Evaluations and dust sampling	Potential asbestos exposure. Physical hazards include confined space entry; and slip, trip, fall, and overhead hazards. Risks associated with ladder use. Risks associated with falls between roof trusses.	Use of buddy system at all times, use of flashlights when necessary, hazard awareness. Sampling will be conducted to limit the potential for exposure. Sample areas will be wetted before sample collection, when necessary. Performance of personal air monitoring at selected locations. Follow Safe Work Practices (SWP)	Level C: protection when accessing all attic spaces	Potential for upgrade to level C protection may be necessary using P-100 cartridges. Full or ½ face respirator can be used. Decision to upgrade to be made by the SSC/Field Manager based on site conditions, monitoring results, and presence of friable asbestos.
Task 2 – Exterior yard and open area inspections and soil sampling	Potential asbestos exposure. Physical hazards include slip, trip, and falls.	Use of buddy system and hazard awareness. Follow Safe Work Practices (SWP)	Level D: protection	Decision to upgrade to be made by the SSC/Field Manager based on site conditions, monitoring results, and presence of friable asbestos.

To reduce the potential for inhaling asbestos, the following steps shall occur:

- Personnel shall avoid sampling methods and procedures that would render nonfriable ACM friable.
- The level of PPE shall be upgraded from level D to level C at any time that sampling conditions warrant, as determined by the SSC and/or Field Manager.

4.2 PHYSICAL HAZARDS

Physical hazards associated with site activities present a potential threat to on-site personnel. Dangers are posed by slippery surfaces, unseen obstacles, poor illumination, use of ladders, and low overhead clearance.

Injuries resulting from physical hazards can be avoided by using safe work practices (SWP). To maintain a safe workplace, the SSC will conduct and document regular safety inspections and will make sure that all Tetra Tech workers and visitors are informed of any potential physical hazards related to the site. Physical hazards that have been identified at this site include the following:

- Use of ladders and other equipment to access attics and areas for sample collection
- Trips, slips, falls in yards and open areas
- Heat stress
- Cold stress
- Fall hazard (from ladders and through roof trusses in attics)
- Potential confined space entry – no permits are anticipated to be necessary to perform sampling activities

5.0 TRAINING REQUIREMENTS

All on-site personnel who may be exposed to hazardous conditions, including Tetra Tech and subcontractor personnel and site visitors who will participate in on-site activities, will be required to meet training requirements outlined in 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response." All personnel and visitors entering the site will be required to review this HASP and sign the Compliance Agreement form (HSP-4), and site workers will be required to sign the Daily Tailgate Safety Meeting form (HST-2) (see Appendix A).

Personnel conducting asbestos sampling will, at a minimum, be a licensed asbestos inspector within the State of Montana and be 40-hour HAZWOPER trained.

Before on-site activities begin, the Tetra Tech SSC will present a briefing for all personnel who will participate in on-site activities. The following topics will be addressed during the prework briefing:

- Names of the SSC and the designated alternate
- Site history
- Work tasks
- Hazardous chemicals that may be encountered on site
- Physical hazards that may be encountered on site
- PPE, including type or types of respiratory protection to be used for work tasks
- Training requirements
- Action levels and situations requiring upgrade or downgrade of level of protection
- Site control measures, including site communications, and SWPs
- Decontamination procedures
- Emergency communication signals and codes
- Personnel exposure and accident emergency procedures (in case of falls, exposure to hazardous substances, and other hazardous situations)
- Emergency telephone numbers
- Emergency routes

Any other health and safety-related issues that may arise before on-site activities begin will also be discussed during the pre-work briefing.

Issues that arise during implementation of on-site activities will be addressed during tailgate safety meetings to be held daily before the workday or shift begins and will be documented in the Daily Tailgate Safety Meeting form (Form HST-2 in Appendix A). Any changes in procedures or site-specific health and safety-related matters will be addressed during these meetings.

6.0 PERSONAL PROTECTION REQUIREMENTS

The levels of PPE to be used for work tasks during the TAPE will be selected based on known or anticipated physical hazards; types and concentrations of contaminants that may be encountered on site; and contaminant properties, toxicity, exposure routes, and matrices. The following sections describe protective equipment and clothing; reassessment of protection levels; limitations of protective clothing; and respirator selection, use, and maintenance.

6.1 PROTECTIVE EQUIPMENT AND CLOTHING

Personnel will wear protective equipment when (1) site activities involve known or suspected contamination; (2) site activities may generate asbestos particulates; or (3) direct contact with hazardous materials may occur. The anticipated levels of protection selected for use by field personnel during site activities are listed in Table 4-2, Task Hazard Analysis. Based on the anticipated hazard level, personnel will initially perform field tasks in level D protection.

If site conditions or the results of air monitoring performed during on-site activities warrant a higher level of protection, all field personnel will immediately notify the Tetra Tech SSC. Based on the initial site walk through and conditions encountered during sample collection, a PPE upgrade to level C protection is anticipated in some of the areas being sampled. This PPE upgrade will typically occur whenever vermiculite-containing insulation (VCI) or Libby vermiculite (LV) is encountered. Descriptions of equipment and clothing required for level D, level C, and level B protection are provided below.

- Level D
  - Coveralls or work clothes, if applicable
  - Chemical-resistant clothing (such as Tyvek or Saranex coveralls)
  - Disposable gloves (latex or vinyl), if applicable
  - Work gloves, if applicable
  - Boots with steel-toe protection and steel shanks
  - Disposable boot covers or chemical-resistant outer boots, if applicable

  - Safety glasses or goggles
  - Hard hat (face shield optional)
  - Hearing protection (for areas with a noise level exceeding 85 decibels on the A-weighted scale)

- Level C
  - Coveralls or work clothes, if applicable
  - Chemical-resistant clothing (such as Tyvek or Saranex coveralls)
  - Outer gloves (neoprene, nitrile, or other), if applicable
  - Disposable inner gloves (latex or vinyl)
  - Boots with steel-toe protection and steel shanks
  - Disposable boot covers or chemical-resistant outer boots
  - Full- or half-face, air-purifying respirator with National Institute for Occupational Safety and Health (NIOSH)-approved cartridges to protect against organic vapors, dust, fumes, and mists (cartridges used for gas and vapors must be replaced in accordance with the change-out schedule described in the Respiratory Hazard Assessment form [Form RP-2] in Appendix C). P-100 cartridges will be used.
  - Safety glasses or goggles (with a half-face respirator only)
  - Hard hat (face shield optional)
  - Hearing protection (for areas with a noise level exceeding 85 decibels on the A-weighted scale)

6.2 REASSESSMENT OF PROTECTION LEVELS

PPE levels shall be upgraded or downgraded based on a change in site conditions or investigation findings. When a significant change in site conditions occurs, hazards will be reassessed. Some indicators of the need for reassessment are as follows:

- Commencement of a new work phase, such as the start of a significantly different sampling activity or work that begins on a different portion of the site
- Potential for release of amphibole asbestos
- A change in job tasks during a work phase
- A change of season or weather
- Temperature extremes or individual medical considerations limiting the effectiveness of PPE
- Discovery of contaminants other than those previously identified

- A change in ambient levels of airborne contaminants (see the action levels listed in Table 8-1)
- A change in work scope that affects the degree of contact with contaminated media

6.3 LIMITATIONS OF PROTECTIVE CLOTHING

PPE clothing ensembles designated for use during site activities have been selected to provide protection against contaminants at known or anticipated on-site concentrations and physical states. However, no protective garment, glove, or boot is entirely chemical-resistant, nor does any protective clothing provide protection against all types of chemicals. Permeation of a given chemical through PPE depends on the contaminant concentration, environmental conditions, physical condition of the protective garment, and resistance of the garment to the specific contaminant. Chemical permeation may continue even after the source of contamination has been removed from the garment.

All site personnel will use the following procedures to obtain optimum performance from PPE.

- When chemical-protective coveralls become contaminated, don a new, clean garment after each rest break or at the beginning of each shift.
- Inspect all clothing, gloves, and boots both before and during use for the following:
  - Imperfect seams
  - Nonuniform coatings
  - Tears
  - Poorly functioning closures
- Inspect reusable garments, boots, and gloves both before and during use for visible signs of chemical permeation, such as the following:
  - Swelling
  - Discoloration
  - Stiffness
  - Brittleness
  - Cracks
  - Punctures
  - Abrasions

Reusable gloves, boots, or coveralls exhibiting any of the characteristics listed above must be discarded. Reusable PPE will be decontaminated in accordance with procedures described in Section 10.0 and will be neatly stored in the support zone away from work zones.

6.4 RESPIRATOR SELECTION, USE, AND MAINTENANCE

Tetra Tech personnel will be informed of the proper use, maintenance, and limitations of respirators during annual health and safety refresher training and the prework briefing. Any on-site personnel who will use a tight-fitting respirator must pass a qualitative fit test for the respirator that follows the fit testing protocol provided in Appendix A of the OSHA respirator standard (29 CFR 1910.134). Fit testing must be repeated annually or when a new type of respirator is used.

Respirator selection is based on the assessment of the nature and extent of hazardous atmospheres anticipated during field activities. This assessment includes a reasonable estimate of employee exposure to respiratory hazards and identification of each contaminant’s anticipated chemical form and physical state.

For each work task requiring respirator use during the TAPE project, a respiratory hazard assessment has been conducted. The results of this assessment are documented in the Respiratory Hazard Assessment form (Form RP-2), which has been approved by the HSR. The completed Form RP-2 is included in Appendix C and defines respiratory protection requirements for the project. Amendments to this HASP and to Form RP-2 will be discussed during daily tailgate safety meetings.

When the atmospheric contaminant is identified and its concentration is known or can be reasonably estimated, respiratory protection options include the following:

- An atmosphere-supplying respirator (air-line or SCBA)
- An air-purifying respirator equipped with a NIOSH-certified, end-of-service-life indicator (ESLI) for the identified contaminant. If no ESLI is available, a change-out schedule for cartridges must be developed based on objective data or information. Respirator cartridge selection and change-out schedules will be evaluated by the HSR at the time of the respiratory hazard assessment. The Respiratory Hazard Assessment, Form RP-2, will describe the information and data used as the basis for the cartridge change-out schedule and the proposed change schedule.

For protection against particulate contaminants including friable asbestos, approved respirators can include the following:

- An atmosphere-supplying respirator
- A respirator equipped with a filter certified by NIOSH under 32 CFR Part 11 or 42 CFR Part 84 as a P100 filter (formerly known as a high-efficiency particulate air [HEPA] filter)

For any tasks performed in Level C PPE, a full- or half-face, air-purifying respirator equipped with NIOSH-approved cartridges or filters will be selected to protect against particulates, vapors, gases, and aerosols.

Air-purifying respirators will be used only in conjunction with breathing-space air monitoring, which must be conducted in adherence to the action levels outlined in Table 8-1. Air-purifying respirators will be used only when they can provide protection against the substances encountered on site.

Factors precluding use of Level C and air-purifying respirators are as follows:

- Oxygen-deficient atmosphere (less than 19.5 percent oxygen)
- Concentrations of substances that may be immediately dangerous to life and health
- Confined or unventilated areas that may contain airborne contaminants not yet characterized
- Unknown contaminant concentrations or concentrations that may exceed the maximum use levels for designated cartridges documented in the selected cartridge manufacturer's instructions
- Unidentified contaminants
- High relative humidity (more than 85 percent, which reduces the sorbent life of the cartridges)
- Respirator cartridges with an undetermined service life

Use, cleaning, and maintenance of respirators are described in SWP 6-27, Respirator Cleaning Procedures, and SWP 6-28, Safe Work Practices for Use of Respirators. These SWPs are included in Appendix B.

7.0 MEDICAL SURVEILLANCE

The following sections describe Tetra Tech's medical surveillance program, including health monitoring requirements, site-specific medical monitoring, and medical support and follow-up requirements. Procedures documented in these sections will be followed for all activities during the TAPE project. Additional requirements are defined in the Tetra Tech, Inc., "Health and Safety Manual."

7.1 HEALTH MONITORING REQUIREMENTS

All Tetra Tech and subcontractor personnel involved in on-site activities for the TAPE project must participate in a health monitoring program as required by 29 CFR 1910.120(f). Tetra Tech has established a health monitoring program with WorkCare, Inc., of Orange, California. Under this program, Tetra Tech personnel receive baseline and annual or biennial physical examinations consisting of the following:

- Complete medical and work history
- Physical examination
- Vision screening
- Audiometric screening
- Pulmonary function test
- Resting electrocardiogram
- Chest x-ray (required once every 3 years)
- Blood chemistry, including hematology and serum
- Urinalysis
- For sampling asbestos licensed workers will meet the medical monitoring requirements of their licenses

For each employee, Tetra Tech receives a copy of the examining physician's written opinion after postexamination laboratory tests have been completed; the Tetra Tech employee also receives a copy of the written opinion. This opinion includes the following information (in accordance with 29 CFR 1910.120[f][7]):

- The results of the medical examination and tests
- The physician's opinion as to whether the employee has any medical conditions that would place the employee at an increased risk of health impairment from work involving hazardous waste operations or during an emergency response
- The physician's recommended limitations, if any, on the employee's assigned work; special emphasis is placed on fitness for duty, including the ability to wear any required PPE under conditions expected on site (for example, temperature extremes)
- A statement that the employee has been informed by the physician of the medical examination results and of any medical conditions that require further examination or treatment

All subcontractors must have health monitoring programs conducted by their own clinics in compliance with 29 CFR 1910.120(f). Any visitor or observer at the site will be required to provide records in compliance with 29 CFR 1910.120(f) before entering the site.

7.2 MEDICAL SUPPORT AND FOLLOW-UP REQUIREMENTS

As a follow-up to an injury requiring care beyond basic first aid or to possible exposure above established exposure limits, all employees are entitled to and encouraged to seek medical attention and physical testing. Such injuries and exposures must be reported to the HSR. Depending on the type of injury or exposure, follow-up testing, if required, must be performed within 24 to 48 hours of the incident. It will be the responsibility of the employer's medical consultant to advise the type of test required to accurately monitor for exposure effects. The Accident and Illness Investigation Report (Form AR-1 in Appendix A) must be completed by the Tetra Tech SSC in the event of an accident, illness, or injury. A copy of this form must be forwarded to the HSR for use in determining whether the incident should be recorded and for inclusion in Tetra Tech's medical surveillance records.

8.0 ENVIRONMENTAL MONITORING AND SAMPLING

Environmental monitoring or sampling will be conducted to assess personnel exposure levels as well as site or ambient conditions and to determine appropriate levels of PPE for work tasks. The following sections discuss initial and background air monitoring, personal monitoring, ambient air monitoring, monitoring parameters and devices, use and maintenance of survey equipment, thermal stress monitoring, and noise monitoring. Site-specific air monitoring requirements and action levels are provided in Table 8-1.

TABLE 8-1

SITE-SPECIFIC AIR MONITORING REQUIREMENTS AND ACTION LEVELS

Contaminant or Hazard	Task	Monitoring Device	Action Level	Monitoring Frequency	Action[a]
Asbestos	Task 1 &2	Gilair-5 Air Sampler (personal)	<one half of PEL or TLV	Select locations – presence of friable asbestos	Results will be received the day following sampling. Work practices will be changed accordingly.

Notes:

>	Greater than
<	Less than
CGI	Combustible gas indicator
LEL	Lower explosive limit
PEL	Permissible exposure limit
PPE	Personal protective equipment
TLV	Threshold limit value
[a]	Refer to Table 4-2 for specific types of gloves, chemical resistant clothing, respirators, and cartridges

8.1 INITIAL AND BACKGROUND AIR MONITORING

Initial air monitoring of a typical work area will be performed at the beginning of the field sampling project to document airborne fiber levels in attic spaces containing VCI or LV. Initial exposure assessments will be required for personnel conducting the TAPE project. Personal air monitoring will be required during the initial phase of the TAPE to document airborne exposures. The assessments must be used to document typical exposures during specific types of field activities in order to establish the required PPE. This exposure assessment will be conducted for each 2-person field sampling team. The exposure levels must be documented prior to downgrading the levels of PPE required during the work. The assessments must also be conducted using personal air sampling whenever there is a change in working conditions.

8.2 PERSONAL MONITORING

The employees working closest to a source of contamination have the highest likelihood of exposure to airborne contaminant concentrations that may exceed established exposure limits. Therefore, selective monitoring of the workers who are closest to a source of contaminant generation will be conducted during site activities. Personal monitoring shall be conducted in the breathing zone and, if a worker is wearing respiratory protective equipment, outside the face piece. Monitoring of the breathing zone air will be conducted at select locations, such as in the presence of friable asbestos.

In order to ensure that employee exposure remains below the prescribed PEL and/or excursion limit, air monitoring shall be performed to calculate the airborne fiber concentration. The worker's exposure shall be determined by first collecting an air sample from within his/her breathing zone (within 12" from the nose) throughout an entire workshift. This usually necessitates that workers wear the pump near their waist. The personal air monitoring shall be evaluated based on the different work activities that are being conducted by the workers. A representative set of air samples shall be collected during activities that represent typical field days during the TAPE.

The sampling pump flow rates will be between 0.5 liters/min. and 2.5 liters/min when using a 25 mm cassette. Once this sample is analyzed, the results shall be used to calculate the average level of exposure during the complete workshift (TWA). TWA calculations are performed as follows:

$$TWA = \frac{C1\,T1 + C2\,T2 + C3\,T3}{T1 + T2 + T3}$$

T = sample times (duration of exposure in minutes or hours)
C = airborne asbestos fiber concentration (f/cc)

The TWA results shall then be used for comparison to the PEL and to determine compliance with permissible exposure limits as established by OSHA. They shall also be used to dictate which type of respiratory protection is required to ensure that the PEL is not exceeded.

Personal air samples shall also be collected and analyzed in the manner described above for comparison to the EL. The samples shall be collected for 30 minutes during operations.

8.3 AMBIENT AIR MONITORING

Most tasks will require monitoring of the general work area or ambient site conditions. Ambient area sampling will be conducted periodically during the field activities. Initial ambient air monitoring will be performed as a minimum requirement when any of the situations listed below arise.

- Work begins on a different portion of the site
- Contaminants other than those previously identified are encountered
- A different type of operation is initiated
- Workers experience physical difficulties

Periodic ambient air monitoring will be performed at the frequency listed in Table 8-1.

8.4 MONITORING PARAMETERS AND DEVICES

The following sections below briefly describe the use and limitations of instruments used to monitor for asbestos, combustible atmospheres, percent oxygen, and particulates. Site-specific air monitoring requirements and action levels are listed in Table 8-1.

All monitors will be calibrated in accordance with manufacturer recommendations at the beginning of every workday, if possible. Calibration results along with air monitoring data will be recorded in the field logbook.

8.4.1 Asbestos

Air monitoring will be conducted selectively during sampling activities to provide exposure information and identify the need for upgrades from level D PPE to level C PPE. In addition, air monitoring will be conducted to make certain that asbestos is not being released to the areas used by individuals as a result of sampling activities.

Work being performed during the TAPE will be initially conducted in level D PPE; however, level C PPE will be required whenever attic access is required or whenever sampling of VCI or LV occurs. The action level for sampling activities is one-half of the permissible exposure limit (PEL) (0.05 fiber per cubic centimeter [fiber/cm^3]). Additionally, upgrade to level C PPE will also be based on the material being sampled and at the discretion of the SSC. Personal air monitoring for particulates will be conducted and analyzed by a laboratory. Laboratory results will be received post exposure (less than one day) to assess sampling conditions and change PPE accordingly.

8.4.2 Percent Oxygen

Hazardous conditions exist whenever the oxygen level is too high or too low. If such an environment is encountered during the TAPE, monitoring for percent oxygen will be conducted to verify that a safe oxygen level is present for sampling activities. Workers must never enter or remain in low-oxygen atmospheres unless they are wearing supplied air respirators (air-line or SCBA). An oxygen-enriched atmosphere is hazardous because it increases the risk of fire. The monitoring device, monitoring frequency, and general action levels for oxygen-deficient and –enriched atmospheres during site activities are outlined in Table 8-1.

8.4.3 Particulates

Friable asbestos is anticipated to be encountered during sampling activities. Other particulates such as mineral wood, fiberglass and other insulating materials may be encountered in attic areas but are not known.

Particulate air monitoring is the process of measuring the fiber content of a known volume of air collected during a specific period of time. The acceptable procedure for airborne asbestos measurement for personal exposure monitoring is phase contrast microscopy (PCM) using the OSHA reference method specified in Appendix A of 29 CFR 1926.1101. This NIOSH 7400 Method is also acceptable for measuring airborne fiber levels in area samples. The OSHA asbestos regulations, which contain the permissible exposure limit (PEL), were written to regulate asbestos related activities typically found within industrial or construction settings. OSHA assumes that, within these settings, the majority of the airborne fibers will be asbestos. In line with this assumption, the OSHA PEL is based on total airborne fiber exposures and not specifically airborne asbestos fibers.

The acceptable procedure for airborne asbestos measurement by transmission electron microscopy (TEM) is the method specified in EPA 40 CFR 763, Appendix A to Subpart E, Interim Transmission Electron Microscopy Analytical Methods. TEM sampling provides greater analytical sensitivity and can differentiate between asbestos and non-asbestos fibers. TEM sampling will be limited during the TAPE. TEM samples will only be collected if PCM samples can not be analyzed due to overloading from nuisance particulates, or when fiber differentiation is necessary.

Table 8-1 lists the monitoring device, monitoring frequency, and general action levels expected to be used during site activities.

8.5 USE AND MAINTENANCE OF SURVEY EQUIPMENT

All personnel using field survey equipment must have training in its operation, limitations, and maintenance. Maintenance and internal or electronic calibration will be performed in accordance with manufacturer recommendations by individuals familiar with the devices before their use on site. Repairs, maintenance, and internal or electronic calibration of these devices will be recorded in an equipment maintenance logbook. Results of routine calibration will be recorded on daily air sampling data sheets.

8.6 THERMAL STRESS MONITORING

Heat stress and cold stress are common and serious threats at hazardous waste sites. SWPs 6-15 and 6-16 discuss heat and cold stress, respectively, and include monitoring methods appropriate for the season and location of work (see Appendix B).

8.7 NOISE MONITORING

In most cases, high noise levels at a work site are caused by heavy equipment, such as drill rigs and backhoes, or sources associated with the work site, such as factory equipment and vehicles. When noise levels during the TAPE project are suspected to equal or exceed an 8-hour time-weighted average (TWA) of 85 decibels on an A-weighted scale (85 dBA) in slow response mode, the Tetra Tech SSC will evaluate the work area to characterize the noise source and exposure levels. A sound level meter may be used for the evaluation but a noise dosimeter is recommended for documenting full-shift noise exposures, when deemed appropriate. If neither instrument is available, the SSC may use a simple rule-of-thumb test to determine whether noise levels exceed 85 dBA. The test requires the SSC to determine how loud he or she must speak to be heard at an arm's length from another person. If the SSC must raise his or her voice to be heard, the average noise level likely exceeds 85 dBA.

If employees are exposed to noise levels that exceed the action level of 85 dBA, hearing protection must be worn. The protectors will be earplugs or muffs that must provide sufficient attenuation to limit noise exposure to less than 85 dBA. The SSC will supervise use of hearing protectors at the work site as necessary. Table 8-1 lists the monitoring device and action levels to be used.

9.0 SITE CONTROL

Site control is an essential component in HASP implementation. The following sections discuss measures and procedures for site control, such as on-site communications, site control zones, site access control, site safety inspections, and SWPs.

9.1 ON-SITE COMMUNICATIONS

Successful communication between field teams and personnel is essential. The following communication systems will be available during site activities:

- Cellular telephones or two-way radios

The hand signals listed below will be used by site personnel in emergency situations or when verbal communication is difficult.

Signal	Definition
Hands clutching throat	Out of air or cannot breathe
Hands on top of head	Need assistance
Thumbs up	Okay, I am all right, or I understand
Thumbs down	No or negative
Arms waving upright	Send backup support
Gripping partner's wrist	Exit area immediately

9.1 SITE CONTROL ZONES

9.2.1 Zone 1: Exclusion Zone

An exclusion zone includes areas where contamination is either known or likely to be present or, because of work activity, has the potential to cause harm to personnel. Typically, during the TAPE, these areas will be limited to attics and crawl spaces. The exclusion zone will be established before Tetra Tech employees access attic and crawl space areas to conduct sampling. Other building occupants and visitors will be restricted from entering the exclusion zone during sampling procedures. Work tasks that may require establishment of an exclusion zone include the following:

Task 1– Interior sampling of VCI and LV in attics and crawl spaces.

Exclusion zones will not be established during the collection of dust samples within other interior areas of buildings or during the collection of soil samples outside the buildings. However, building occupants should be restricted from the immediate area during these procedures.

9.2.2 Zone 2: Decontamination Zone

A decontamination zone is not expected during the TAPE project. Personal decontamination will entail removal of protective garments before descending from attic areas or exiting crawl spaces. Tetra Tech personal will use disposable wet wipes to wash respirators and exposed areas such as faces and hands before exiting the exclusion zones. Decontamination of sampling equipment will be conducted at the sample locations. Decontamination procedures will consist of a water rinse or damp rag cleaning of equipment after each sample collected. The decontamination zone will contain facilities to decontaminate personnel and portable equipment. Equipment decontamination procedures are described in Section 10.0. All PPE will be place in disposal bags and sealed before Tetra Tech employees exit the exclusion zones. Visitors will not be permitted to enter the decontamination zone without proper qualifications and Tetra Tech SSC authorization.

9.2.3 Zone 3: Support Zone

A support zone may consist of any uncontaminated and nonhazardous part of the site such as at the base of ladders used to access attic spaces or outside of crawl space entrances. These areas will be covered with polyethylene sheeting during sampling activities in the exclusion zones. At any time during the sampling activities after the exclusion zone has been established, if visible suspect asbestos-contaminated debris is observed outside of the sampling areas, sampling procedures shall immediately stop. Clean-up debris/residue using appropriate HEPA vacuuming and/or wet cleaning procedures before work recommences. Site visitors not meeting training, medical surveillance, and PPE requirements must stay outside of the support zone.

9.3 SITE ACCESS CONTROL

The study area during this project will not be one stationary location. Access to private residences will be permitted by the owner. Owner/occupants should be restricted from the immediate sampling areas during sampling procedures. Typically, they should be asked to stay in adjacent rooms during sampling procedures.

9.4 SITE SAFETY INSPECTIONS

Periodic site safety inspections shall be conducted by the Tetra Tech SSC to maintain safe work areas and compliance with this HASP. Results of the site safety inspections will be recorded in the field logbook or on a Field Audit Checklist (Form AF-1 in Appendix A).

9.5 SAFE WORK PRACTICES

Various SWPs are applicable during the TAPE project. These SWPs are included in Appendix B to this HASP. The following SWPs apply to the site:

- SWP 6-1, General Safe Work Practices
- SWP 6-8, Safe Electrical Work Practices
- SWP 6-9, Fall Protection Practices
- SWP 6-10, Portable Ladder Safety
- SWP 6-15, Heat Stress
- SWP 6-16, Cold Stress
- SWP 6-27, Respirator Cleaning Procedures
- SWP 6-28, Safe Work Practices for Use of Respirators

10.0 DECONTAMINATION

Decontamination is the process of removing or neutralizing contaminants on personnel or equipment. When properly conducted, decontamination procedures protect workers from contaminants that may have accumulated on PPE, tools, and other equipment. Proper decontamination also prevents transport of potentially harmful materials to uncontaminated areas. Personnel and equipment decontamination procedures are described in the following sections.

10.1 PERSONNEL DECONTAMINATION

Personnel decontamination at the site will be limited by using disposable PPE whenever possible and wet wiping of faces and hands after sampling procedures. Any personnel decontamination procedures will follow guidance in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH and others 1985). Personnel and PPE will be decontaminated with potable water or a mixture of detergent and water. Disposable cloths or wet wipes will be placed in sealable baggies pending disposal.

10.2 EQUIPMENT DECONTAMINATION

Decontamination of all sampling, PPE, and field monitoring equipment used during site activities will be required. Decontamination of sampling equipment will be conducted at the sample locations. Decontamination procedures will consist of a water rinse or damp rag cleaning of equipment after each sample collected.

10.2.1 PPE and Monitoring Equipment

Used, disposable PPE will be collected in sealable containers and will be disposed of in accordance with procedures described in the project specific work plan. Personnel decontamination procedures may be modified as necessary while on site. All non-disposable PPE such as hard hats, respirators, and any exposed clothing will be washed at the end of each workday, or as necessary depending on working conditions, to remove all potential for asbestos contamination. Monitoring equipment used during sampling activities will be rinsed with water at the end of each workday, or as necessary to remove any contamination.

10.2.2 Sampling Equipment

Sampling equipment, such as knives and scissors, will be decontaminated before and after each use as described below.

- Sampling equipment decontamination procedures will depend on the sampling location. Equipment such as knives and scissors will, in most sampling situations, be decontaminated by wiping down with damp cloths or rags. Soap and water may be necessary when items are excessively dirty but is not mandatory.
- Sampling equipment will be allowed to air-dry before next use.

11.0 EMERGENCY RESPONSE PLANNING

This section describes emergency response planning procedures to be implemented for the site. This section is consistent with local, state, and federal disaster and emergency management plans. The following sections discuss pre-emergency planning, personnel roles and lines of authority, emergency recognition and prevention, evacuation routes and procedures, emergency contacts and notifications, hospital route directions, emergency medical treatment procedures, protective equipment failure, fire or explosion, weather-related emergencies, spills or leaks, emergency equipment and facilities, and reporting.

11.1 PRE-EMERGENCY PLANNING

During the prework briefing and daily tailgate safety meetings, all on-site employees will be trained in and reminded of the provisions of Section 11.0, site communication systems, and site evacuation routes. The emergency response provisions will be reviewed on a regular basis by the Tetra Tech SSC and will be revised, if necessary, to make certain that they are adequate and consistent with prevailing site conditions.

11.2 PERSONNEL ROLES AND LINES OF AUTHORITY

The Tetra Tech SSC has primary responsibility for responding to and correcting emergency situations and for taking appropriate measures to maintain the safety of site personnel and the public. Possible actions may include evacuation of personnel from the site area. The SSC is also responsible for ensuring that corrective measures have been implemented, appropriate authorities have been notified, and follow-up reports have been completed.

Individual subcontractors are required to cooperate with the SSC, within the parameters of their scopes of work.

Personnel are required to report all injuries, illnesses, spills, fires, and property damage to the SSC. The SSC must be notified of any on-site emergencies and is responsible for following the appropriate emergency procedures described in this section.

11.3 EMERGENCY RECOGNITION AND PREVENTION

Table 4-1 lists potential on-site chemical hazards, and Table 4-2 provides information on the hazards associated with the different tasks planned for the site. On-site personnel will be made familiar with this information and with techniques of hazard recognition through prework training and site-specific briefings.

11.4 EVACUATION ROUTES AND PROCEDURES

In the event of an emergency that necessitates evacuation of a work task area or the site, the Tetra Tech SSC shall contact all nearby personnel using the on-site communication systems discussed in Section 9.1 to advise the personnel of the emergency. The personnel will proceed along site roads to a safe distance upwind from the hazard source. The personnel will remain in that area until the SSC or an authorized individual provides further instructions.

11.5 EMERGENCY CONTACTS AND NOTIFICATIONS

The emergency information before Section 1.0 of this HASP provides names and telephone numbers of emergency contact personnel. THIS PAGE MUST BE POSTED ON SITE OR MUST BE READILY AVAILABLE AT ALL TIMES. In the event of a medical emergency, personnel will notify the appropriate emergency organization and will take direction from the Tetra Tech SSC. The project team will follow procedures discussed in Section 11.9 or 11.11.

11.6 HOSPITAL ROUTE DIRECTIONS

Before performing any site activities, Tetra Tech personnel will conduct a pre-emergency hospital run to familiarize themselves with the route to the local hospital. A map showing the hospital route is provided in the emergency information before Section 1.0 of this HASP.

11.7 EMERGENCY MEDICAL TREATMENT PROCEDURES

A person who becomes ill or injured during work tasks may require decontamination. If the illness or injury is minor, any decontamination necessary will be completed and first aid should be administered before patient transport. If the patient's condition is serious, partial decontamination will be completed (such as complete disrobing of the person and redressing the person in clean coveralls or wrapping in a blanket). First aid should be administered until an ambulance or paramedics arrive. All injuries and illnesses must be reported immediately to the Tetra Tech project manager and HSR.

Any person transported to a clinic or hospital for chemical exposure treatment will be accompanied by information on the chemical he or she has been exposed to at the site, if possible. Table 4-1 contains this information.

11.8 PROTECTIVE EQUIPMENT FAILURE

If any worker in the exclusion zone experiences a failure of protective equipment (either engineering controls or PPE) that affects his or her personal protection, the worker and all coworkers will immediately leave the exclusion zone. Re-entry to the exclusion zone will not be permitted until (1) the protective equipment has been repaired or replaced, (2) the cause of the equipment failure has been determined, and (3) the equipment failure is no longer considered to be a threat.

11.9 FIRE OR EXPLOSION

In the event of a fire or explosion on site, fire department will be immediately summoned. The Tetra Tech SSC or a site representative will advise the fire department of the location and nature of any hazardous materials involved. Appropriate provisions of Section 11.0 will be implemented by site personnel.

11.10 WEATHER-RELATED EMERGENCIES

Work shall not be conducted during severe weather conditions, including high-speed winds or lightning. In the event of severe weather, field personnel will stop work, secure and lower all equipment and leave the site.

Thermal stress caused by excessive heat or cold may occur as a result of extreme temperatures, workload, or the PPE used. Heat and cold stress treatment will be administered as described in SWPs 6-15 and 6-16, respectively.

11.11 EMERGENCY EQUIPMENT AND FACILITIES

The following emergency equipment will be available on site:

- First aid kit
- Fire extinguisher
- Site telephones depending on location
- Mobile telephone
- Confined-space entry equipment, as necessary
- Fall protection equipment, as necessary

11.12 REPORTING

All emergency situations require follow-up and reporting. Appendix A includes the Tetra Tech Accident and Illness Investigation Report (Form AR-1). This report must be completed and submitted to the Tetra Tech project manager within 24 hours of an emergency situation. The project manager will review the report and then forward it to the Tetra Tech HSR for review. The report must include proposed actions to prevent similar incidents from occurring. The HSR must be fully informed of the corrective action process so that she may implement applicable elements of the process at other sites.

REFERENCES

American Conference of Governmental Industrial Hygienists (ACGIH). “Threshold Limit Values and Biological Exposure Indices for 1998.” Latest edition.

National Institute for Occupational Safety and Health (NIOSH) and others. 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. October.

NIOSH. 1997. “Pocket Guide to Chemical Hazards.” U.S. Department of Health and Human Services. U.S. Government Printing Office. Washington, DC. June.

Tetra Tech, Inc. 1999. “Health and Safety Manual.”

APPENDIX A

TETRA TECH FORMS

(11 Sheets)

- Compliance Agreement (Form HSP-4)
- Daily Tailgate Safety Meeting (Form HST-2)
- Daily Site Log (Form SSC-1)
- Accident and Illness Investigation Report (Form AR-1)
- Field Audit Checklist (Form AF-1)

APPENDIX B

SAFE WORK PRACTICES

(38 Sheets)

- SWP 6-1 General Safe Work Practices
- SWP 6-9 Fall Protection Practices
- SWP 6-10 Portable Ladder Safety
- SWP 6-15 Heat Stress
- SWP 6-16 Cold Stress
- SWP 6-27 Respirator Cleaning Procedures
- SWP 6-28 Safe Work Practices for Use of Respirators

APPENDIX C

RESPIRATORY HAZARD ASSESSMENT (FORM RP-2)

(Two Sheets)

Note: This assessment form will be finalized if gasses or vapors are encountered and is not required for asbestos sampling activities.

ATTACHMENT D

MATERIAL SAFETY DATA SHEETS

(None Anticipated)

Troy, MT Inspection Field Form

Address: ____

Building number: BD- ___________ (Insert at top right of each page of form)

Commercial or residential property (circle one)? Commercial Residential Both

Site visit date and time: ____

Field log book number and page: ____

Inspection team members: ____

Owner/primary contact providing access: ____________________________________

Phone number for primary contact: ____

Inspection Item	Value	Comments
ATTIC		
Type of attic	Finished Unfinished	
Multiple attics?	Yes No Attics within attics	
Location of attic entries	Inside house Outside house None	*Sketch location on property map*
Number of attic entries	1 2 3 Other:____	
Type of attic entry	Stairs Door Removable panel Other: _______________	*If unusual shape/size, please note*
Attic used for storage?	Yes No	*Brief description:*
Kneewalls present?	Yes No	
Areas behind kneewalls accessed?	Yes No	*If yes, describe access:*
Areas behind kneewalls used for storage?	Yes No	*Brief description:*

Is finished attic furnished?	Yes No	*Brief description:*
Factors impeding potential cleanup? (i.e., presence of support beams/exposed electrical wires/HVAC)	Yes No	*Brief description:*
General condition of ceiling and floors	Good Poor	
Can all areas in attic be accessed?	Yes No	
Are any areas in attic segregated into individual rooms?	Yes No	*Brief description:*
Attic shows evidence of physical damage?	Yes No	*Brief description:*
Attic shows evidence of water damage?	Yes No	*Brief description:*
Apparent structural condition of roof	Good Poor	
Any other structural concerns?		
VCI observed in attic?	Yes No	*Sketch on property map and describe:*
Depth of VCI in attic	____________ inches	
Square footage of area with VCI?	____________ square feet	
Items in attic in contact with VCI?	Yes No	*Brief description:*
Other insulation in attic?	Yes No	*Type: Fiberglass Cellulose Other ______________*
VCI in interior walls?	Yes No Unknown	
VCI in exterior walls?	Yes No Unknown	
Other insulation in walls?	Yes No Unknown	*Type: Fiberglass Cellulose Other ______________*

Is other insulation in contact with VCI?	Yes No	*Brief description:*
Is VCI visibly leaking into living space?	Yes No	*Brief description:*
LIVING SPACE		
Number and type of room in building; furnished/unfurnished	Basement: Ground floor: First floor: Second floor: Other: ____	
Ceiling cracks as viewed from living space?	Yes No	*Sketch on property map*
Utility conduits in attic leading to living space?	Yes No	*Sketch on property map*
If yes, was VCI observed around conduits?	Yes No	
Is VCI visible in HVAC registers?	Yes No	
Vermiculite observed in houseplant soil?	Yes No	*Describe:*
Evidence of vermiculite used in building materials?	Yes No	*Describe:*
UTILITIES		
Heating system for house:	Fuel Oil Electric Propane Wood Stove Other: ________________	
Heating type:	Forced air Radiant heat	
Electrical shutoff system observed?	Breaker box Fuse box Other: ______________	*Sketch on property map*
Water source	City water Private well Other: ________________	

UNDERSTRUCTURE		
Type of understructure	Basement Crawlspace Other: ________________ None	
Access to understructure	Yes No	*Locations:*
VCI observed in understructure?	Yes No	
EXTERIOR INSPECTION		
Evidence of vermiculite used in building materials?	Yes No	
Visible vermiculite on property?	Yes No	*Sketch on property map*
Vegetation/cover *contaminated area only*	Grass None Other: ______________	
Trees within contaminated area?	Yes No	*Locations, type and size:*
Shrubs within contaminated area?	Yes No	*Locations, type and size:*
Fence present within contaminated area?	Yes No	*Describe:*
Items located on contaminated area?	Yes No	*Describe:*
Number of flowerbeds that have visible vermiculite in soil?		*Sketch on property map*
Contaminated flowerbeds contain flowers/plants?	Yes No	*Describe:*
Number of gardens that have visible vermiculite in soil?		*Sketch on property map*
Garden contains crops?	Yes No	*Describe:*
Type of driveway:	Concrete Gravel Asphalt Soil Other _________________ None	

Visual evidence of contamination in driveway?	Yes No	*Describe:*
If visual evidence of contamination, approximate dimensions:	Length ___________ feet Width ___________ feet	
Vermiculite observed in flower pots/ hanging baskets?	Yes No	*Sketch on property map*
Evidence of fill material on property?	Yes No	*Sketch on property map*
Any underground utilities visible or known to be present?	Yes No	*Describe and sketch on property map:*
Any aboveground utilities observed?	Yes No	*Describe and sketch on property map:*
SECONDARY STRUCTURES		
Secondary structures present?	Shed Deck Carport Garage Barn Greenhouse Other: ________________	
VCI observed inside secondary structures?	Yes No	*Describe:*
Other insulation in secondary structures?	Yes No Unknown	*Type: Fiberglass* *Cellulose* *Other* _______________
Is other insulation in contact with VCI?	Yes No	
Secondary structure finished or used for storage?	Finished Unfinished Storage Vacant Other ________________	*Brief description:*
Items in secondary structure in contact with VCI?	Yes No	*Brief description:*
Visual evidence of contamination beneath secondary structures?	Yes No	*Describe:*

PHOTOGRAPH LOG:

1.____

2. ____

3. ____

4. ____

5. ____

6. ____

7. ____

8. ____

9. ____

10. ____

ADDITIONAL INFORMATION:

DRAFT
TROY ASBESTOS PROPERTY EVALUATION WORK PLAN
(FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN)

FOR THE

TROY ASBESTOS PROPERTY EVALUATION PROJECT

Troy Operable Unit of the Libby Asbestos Superfund Site

January 2006

Prepared for:

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
Remediation Division
P.O. Box 200901
Helena, Montana 59620

Contract Number 402014
Contract Task Order Number 41

Prepared by:

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DRAFT

TROY ASBESTOS PROPERTY EVALUATION WORK PLAN
(FIELD SAMPLING PLAN/QUALITY ASSURANCE PROJECT PLAN)

FOR THE

TROY ASBESTOS PROPERTY EVALUATION PROJECT

Prepared for:

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

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DEQ Project Officer:	______________________________ Catherine LeCours	Date: ____________
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Terry Crowell	CDM Libby Sample Coordinator	CDM – Libby, Montana

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FIGURES

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TABLES

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ACRONYMS AND ABBREVIATIONS

AHERA	Asbestos Hazard Emergency Response Act
amsl	Above mean sea level
ASTM	ASTM International (formerly the American Society for Testing and Materials)
CDM	Camp Dresser & McKee
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
cm^2	Square centimeters
CPR	Cardiopulmonary resuscitation
DEQ	Montana Department of Environmental Quality
DEQ/RD	DEQ/Remediation Division
DPHHS	Montana Department of Public Health and Human Services
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
FSDS	Field sampling data sheet
GPS	Global positioning system
HASP	Health and safety plan
HAZWOPER	Hazardous waste operations
IFF	Inspection field form
LA	Libby amphibole
Microvac	Microvacuum
mm	Millimeters
OSHA	Occupational Safety and Health Administration
OU	Operable unit
PPE	Personal protective equipment
PLM	Polarized light microscopy
QA	Quality assurance
QC	Quality control
SOP	Standard operating procedure
TAPE	Troy Asbestos Property Evaluation
Tetra Tech	Tetra Tech EM Inc.
µm	Micrometers

ACRONYMS AND ABBREVIATIONS
(continued)

VCI	Vermiculite-containing insulation
Volpe Center	John A. Volpe National Transportation Systems Center
WP	Work plan

1.0 PROJECT DESCRIPTION AND MANAGEMENT

Tetra Tech EM Inc. (Tetra Tech) received Task Order No. 41 from the Montana Department of Environmental Quality, Remediation Division (DEQ/RD), under DEQ Contract No. 402014. The purpose of this task order is to complete a Troy Asbestos Property Evaluation (TAPE) work plan for the Troy Operable Unit (OU) of the Libby Asbestos Superfund Site. The work plan describes the field and property inspections and sample collection necessary to identify the nature and extent of asbestos-containing vermiculite and the Troy OU property locations that will require remediation.

This work plan document is a combined field sampling plan and quality assurance project plan and is referred to as the TAPE work plan. The TAPE site-specific health and safety plan (HASP) is provided as Appendix A.

Troy, Montana, is located 18 miles northwest of Libby, Montana. From the 1920s until 1990, an active vermiculite mine and associated processing operations was located at Libby. While it was in operation, the vermiculite mine in Libby may have produced 80 percent of the world's supply of vermiculite (EPA 2005). Vermiculite is used primarily for insulation in buildings and as a soil amendment. The vermiculite deposit is contaminated with a form of amphibole asbestos (Libby amphibole [LA]) that is considered a virulent carcinogen. Asbestos is a known carcinogen and is associated with a multitude of respiratory health effects, including asbestosis, lung cancer, and mesothelioma. For decades, vermiculite ore and waste materials were ubiquitous in the Libby community while the mine operated and after its closure.

Some vermiculite mine workers lived in Troy, Montana, and commuted to the mine to work each day. The mine workers were exposed to asbestos-contaminated materials at the mine and processing facilities, and they transported asbestos-contaminated dust to their homes on clothes and equipment. In addition, the asbestos-contaminated vermiculite ore and waste materials in varying forms may have been used for amending soils (as fill or as a conditioner), as construction fill materials, and for insulating buildings in and around Troy.

In 1999, EPA Region 8 dispatched an emergency response team to investigate in response to media reports that described a high rate of asbestos-related deaths in Libby. Originally believed to be a problem limited to the mine workers, the scope has increased. Subsequent environmental investigations have found many areas in and around Libby contaminated with LA. EPA began Comprehensive Environmental Response Compensation and Liability Act (CERCLA, also known as Superfund) emergency response removal actions in Libby in 2000 that continue today. Properties in Troy are being investigated to evaluate whether LA-contaminated vermiculite has been transported to these properties and whether the concentrations would pose health risks to the occupants.

Tables and figures in this document follow the first reference in the text. Appendix A contains the site-specific HASP, Appendix B contains copies of project-applicable standard operating procedures (SOPs), Appendix C is a list of equipment and supplies required for the project, Appendix D is an information packet for residents, and Appendix E contains example TAPE project field forms.

1.1 SITE CONCEPTUAL MODEL

Asbestos exposure is a potential human health concern because chronic inhalation of excessive levels of asbestos fibers suspended in air can result in lung diseases such as asbestosis and mesothelioma. The relationship between asbestos exposure and mesothelioma has been documented, and at least 70 percent of people with mesothelioma report that they have been exposed to asbestos (National Cancer Institute 2005). Figure 1-1 presents a draft Site Conceptual Model for Troy, which identifies exposure pathways by which asbestos fibers from the Libby mine might be inhaled or ingested by humans. The draft site conceptual model will be refined as additional data are acquired and the understanding of actual transport and exposure pathways for Troy is improved. EPA, CDM, and the Montana Department of Public Health and Human Services (Montana DPHHS) have provided additional related background information for the Libby asbestos project and on mesothelioma in Montana (CDM 2003; Montana DPHHS 2005).

1.2 SITE BACKGROUND

Properties in Troy are being investigated to evaluate whether LA-contaminated vermiculite has been transported to these properties and at concentrations that would pose health risks to the occupants.

The Troy OU site is located along the Kootenai River valley at an elevation ranging from 1,850 feet above mean sea level (amsl) at the northern end of the OU to 2,500 feet amsl on the mountain slopes surrounding the valley. The Troy OU site is approximately 8 miles long and up to 1.8 miles wide. Topography of the site consists of relatively flat river valley terraces on both sides of a gently graded Kootenai River. Several tributaries flow into the Kootenai River along the 8-mile stretch contained within the Troy OU site. Figure 1-2 provides a topographic view of the Troy OU site along with the boundary of the study area.

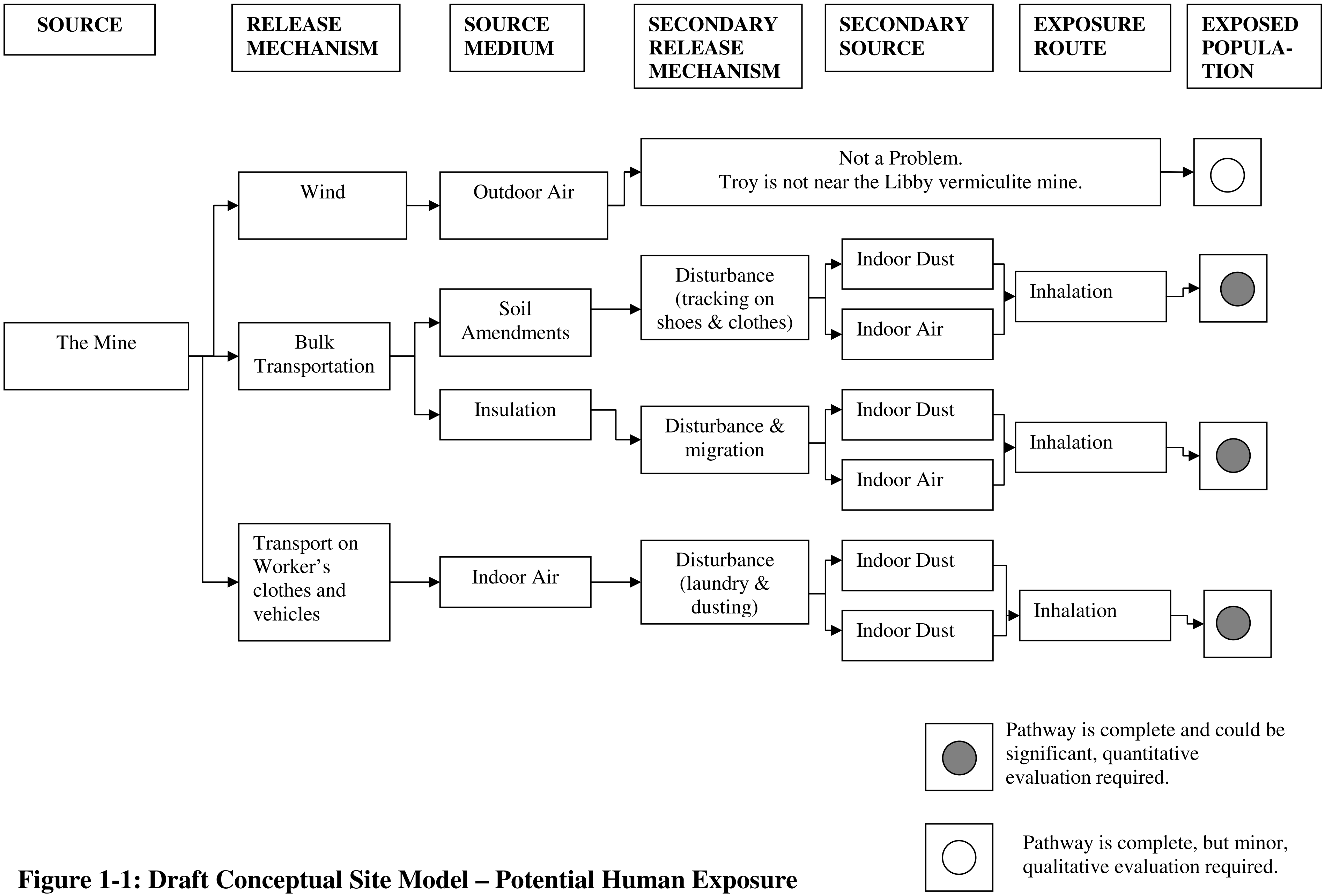

Figure 1-1: Draft Conceptual Site Model – Potential Human Exposure Pathways to Asbestos at the Troy Operable Unit

Figure 1-2: Topographic View of the Troy OU Site

ED MADEJ IS WORKING ON A REVISED BOUNDARY AREA.

1.3 SCHEDULE

Table 1-1 provides the dates for the completion of the draft and final TAPE WP document. The schedule for the TAPE inspection and sampling field work is pending additional funding. The TAPE field work may begin in the summer 2006 and would require approximately 75 full work-days to complete (15 weeks). The soil and dust samples collected from the TAPE field work will be prepared for analysis by CDM and analyzed for asbestos concentrations by an EPA contract laboratory. Tetra Tech should receive all laboratory analytical results within 60 days of submittal to CDM. The draft TAPE project report would be submitted to the DEQ/RD and others approximately 60 days after receiving the analytical data.

TABLE 1-1

SCHEDULE FOR THE TAPE INSPECTION AND SAMPLING PROJECT

Task	Start Date	End Date	Duration[a]
Draft TAPE WP	October 1, 2005	January 31, 2006	120
Consider comments on Draft TAPE WP	TBD	TBD	TBD
Draft Final TAPE WP	TBD February 2006	TBD March 2006	30
Consider comments on Draft Final TAPE WP	TBD	TBD	TBD
Final TAPE WP	TBD April 2006	TBD May 2006	30
Conduct TAPE inspection and sampling – (Begin only at DEQ/RD's request)	TBD Summer 2006	TBD 15 weeks	120

Notes:

a Duration in calendar days
TAPE Troy Asbestos Property Evaluation
WP Work plan
TBD To be determined
Shaded dates are estimates

1.4 REPORT ORGANIZATION

This TAPE work plan is organized into eight sections. Section 1.0 is this introduction. The contents of Sections 2.0 through 8.0 are briefly described below.

- Section 2.0 Project Organization. This section identifies key project personnel and project responsibilities and provides an organizational chart and a table of participants with contact information.

- Section 3.0 Work Plan Rationale. This section describes the data quality objective (DQOs) steps used to establish the quantity and the quality of data to support decision making.

- Section 4.0 Field Procedures. This section describes the activities that will take place during the property evaluations. The SOPs for each activity and the HASP are referenced and detailed.

- Section 5.0 Field Quality Control Procedures: This section discusses the field quality assurance and quality control (QA/QC) procedures, including equipment decontamination, QA samples, field documentation, and chain of custody. Also discussed in this section are QA procedures used at the Libby Asbestos Superfund Site (EPA 2003c).

- Section 6.0 Data Management. This section describes how the data will be handled after they have been received from the Libby V2 database.

- Section 7.0 QA/QC Procedures. This section will describe the procedures that will be taken to ensure the quality and integrity of the TAPE data.

Finally, references used in preparing this document are presented in Section 8.0.

2.0 PROJECT ORGANIZATION

Table 2-1 presents the responsibilities and contact information for key personnel involved in the TAPE inspection and sampling project. In some cases, more than one responsibility has been assigned to a person. Tetra Tech does not plan to use any subcontractors for the TAPE project.

The John A. Volpe National Transportation Systems Center (Volpe Center) is providing support to EPA Region VIII, including management of the Libby V2 database which is used to track sampling and other pertinent data from the Libby Asbestos Superfund Site. Tetra Tech will transfer Troy data to and obtain data from Volpe via EPA or via Volpe's subcontractor, CDM. Tetra Tech will transfer custody of all soil and dust samples to CDM or EPA after the samples have been recorded and organized. CDM will then be responsible for custody and quality assurance of the samples until delivery to an EPA contract laboratory for analysis.

2.1 MONTANA DEQ/RD OVERSIGHT

The DEQ/RD Project Officer, or her designee, will provide oversight of all field activities associated with this TAPE project. The DEQ/RD Project Officer, or her designee, will have the ability to inspect all field and sampling activities, determine the appropriateness of the recorded data, and ensure that all activities comply with standard practices that meet the project objectives. Before any oversight is conducted, the Tetra Tech on-site health and safety coordinator will brief the DEQ oversight personnel to ensure safe practices are maintained throughout the TAPE field effort.

2.2 NON-DEQ/RD OBSERVATION OF FIELD ACTIVITIES

Non-DEQ/RD personnel will be allowed the opportunity to observe field activities associated with this project. The request for non-DEQ/RD observation of field activities must first be coordinated with and approved by the DEQ/RD Project Officer. When inspection and sampling are being conducted on a Troy property and the owners are present, the property owners will have the opportunity to (1) observe Tetra Tech field inspection and sampling, and (2) obtain copies of the field forms and property sketches completed for the property. The Tetra Tech field team will brief property owners about the types of sampling and methods for completing the TAPE inspection and sampling; however, the Tetra Tech field team will not interpret results or conclusions from the inspection and sampling for the property owner.

TABLE 2-1

KEY PERSONNEL

Name	Organization	Role	Responsibilities	Contact Information
Catherine LeCours	DEQ/RD	Project Officer	• Monitors performance of the contractor • Reviews and approves QA measures • Consults with the EPA and Volpe • Reviews and approves all work plans (FSP/QAPP) • Provides coordination with EPA, Volpe, and CDM • Provides primary interface with the Troy community and disseminate project information to the public	Montana Department of Environmental Quality PO Box 200901 Helena, MT 59620-0901 clecours@mt.gov (406) 841-5040
J. Edward Surbrugg	Tetra Tech	TAPE Project Manager	• Responsible for implementing all activities called out in the task order • Supervises preparation of work plan and approves document • Monitors and directs field activities to ensure compliance with work plan requirements • Provides coordination with DEQ/RD Project Officer • Assist with disseminating project information to the Troy community through prepared information packets and directing questions to DEQ/RD	Tetra Tech, Helena, MT 7 West 6th Avenue Helena, MT 59601 edward.surbrugg@ttemi.com (406) 442-5588
Mark Stockwell	Tetra Tech	- TAPE Field Team Leader - TAPE QA/QC Manager	• Responsible for directing and coordinating day-to-day field activities conducted by Tetra Tech • Verifies that field sampling and measurement procedures follow work plan • Conducts field audits for QA/QC • Provides DEQ/RD Project Officer and TAPE project manager with regular reports on status of field activities • Assist with disseminating project information to the Troy community through prepared information packets and directing questions to TAPE PM or DEQ/RD	Tetra Tech, Sandpoint 7 West 6th Avenue Sandpoint, ID mark.stockwell@ttemi.com (208) 263-4524

TABLE 2-1
(Continued)

KEY PERSONNEL

Name	Organization	Role	Responsibilities	Contact Information
Jessica Allewalt	Tetra Tech	Troy Field Sample Coordinator	• Responsible for working with TAPE project manager and TAPE field team leader to schedule TAPE inspections • Responsible for compiling and organizing field data sheets and samples submitted daily by field teams. Enters field data hard copy information into electronic format for transfer to CDM and EPA • Sign custody release of samples to CDM and EPA on a regular basis • Coordinate with CDM, EPA, and Volpe managers on sample delivery schedules and logistics • Reviews laboratory data before release to project team • Disseminate project information packets to interested parties and Troy property owners and direct questions to TAPE PM or DEQ/RD	Tetra Tech, Helena, MT 7 West 6th Avenue Helena, MT 59601 jessica.allewalt@ttemi.com (406) 442-5588
Brett Veltri	Tetra Tech	On-site TAPE Safety Officer	• Responsible for implementing health and safety plan and for determining appropriate site control measures and personal protection levels • Conducts safety briefings for Tetra Tech and site visitors • Can suspend operations that threaten health and safety • Disseminate project information packets to interested parties and Troy property owners and direct questions to TAPE PM or DEQ/RD	Tetra Tech, Helena, MT 7 West 6th Avenue Helena, MT 59601 brett.veltri@ttemi.com (406) 442-5588
Ed Madej	Tetra Tech	Database and Geographic Information System Manager	• Responsible for developing, monitoring, and maintaining project database and property maps • Responds to requests from TAPE project manager and TAPE field team leader to provide copies of property maps to field teams on a daily basis • Works with CDM, Volpe, and EPA data and graphic managers to generate needed reports and maps from the Libby V2 database	Tetra Tech, Helena, MT 7 West 6th Avenue Helena, MT 59601 ed.madej@ttemi.com (406) 442-5588

TABLE 2-1
(Continued)

KEY PERSONNEL

Name	Organization	Role	Responsibilities	Contact Information
10 members	Tetra Tech	Field Team Member	• Responsible for conducting TAPE inspections and sampling as described in the work plan and for following SOPs. • Disseminate project information packets to interested parties and Troy property owners and direct questions to TAPE PM or DEQ/RD	Tetra Tech, Helena, MT 7 West 6th Avenue Helena, MT 59601 (406) 442-5588

Notes:

CDM	Camp Dresser & McKee	DEQ	Montana Dept. of Environmental Quality
EPA	U.S. Environmental Protection Agency	FSP	Field Sampling Plan
QAPP	Quality Assurance Project Plan	SOP	Standard Operating Procedure
TAPE	Troy Asbestos Property Evaluations	Tetra Tech	Tetra Tech EM Inc.
Volpe	John A. Volpe National Transportation Systems Center		
QA/QC	Quality Assurance/Quality Control		

If Tetra Tech obtains soil or dust samples at a property, Tetra Tech will, if requested, provide the property owner with a receipt for the samples identifying the number and types of samples collected before the field crew leaves the property. Sample results may take weeks or months to obtain; therefore, no results will be available during the TAPE inspection and sampling. An individual property owner who requests a split sample must supply all necessary sample bottles, supplies, and materials required for sampling, as well as arrange and pay for laboratory analysis of all split samples collected.

2.3 SPECIAL TRAINING AND CERTIFICATES

Tetra Tech personnel who work on the TAPE project will have met the Occupational Safety and Health Administration (OSHA) training requirements defined in Title 29 Code of Federal Regulations (29 CFR) Part 1910.120(e) for working on hazardous waste sites. These requirements include: (1) 40 hours of formal off-site instruction; (2) a minimum of 3 days of actual on-site field experience under the supervision of a trained and experienced field supervisor; and (3) 8 hours of annual refresher training. In addition, all Tetra Tech personnel working on the TAPE project will have taken the Asbestos Hazard Emergency Response Act (AHERA) 24-hour asbestos inspector training course and will hold a current asbestos inspector license issued by the State of Montana.

Tetra Tech personnel working on the TAPE project must read and abide by the stipulations and guidelines set forth in Tetra Tech's HASP, which is Appendix A to this TAPE work plan. The HASP provides written instructions for health and safety training requirements, personal protective equipment (PPE) requirements, spill containment program, and health-hazard monitoring procedures and techniques. At least one member of every Tetra Tech field team will maintain current certification in the American Red Cross "Multimedia First Aid" and "Cardiopulmonary Resuscitation (CPR) Modular" or equivalent.

Copies of Tetra Tech's health and safety training records, including course completion certifications for the initial and refresher health and safety training, specialized AHERA training, and first aid and CPR training, are maintained in the Helena Tetra Tech office files for all TAPE field team members.

Before work begins at a specific project site, Tetra Tech personnel are required to undergo site-specific training that thoroughly covers the following areas:

- Names of personnel and alternates responsible for health and safety at a project site
- Health and safety hazards present on site
- Selection of the appropriate personal protection levels
- Correct use of PPE
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment on site
- Medical surveillance requirements, including recognition of symptoms and signs that might indicate overexposure to hazardous substances
- Contents of the HASP

3.0 TROY DATA QUALITY OBJECTIVES

This section presents the DQOs for the TAPE inspection and sampling project. The DQOs are qualitative and quantitative statements developed through the seven-step DQO process (EPA 2000a, 2000b). The DQOs help to clarify the study objectives, define the most appropriate data to collect and the conditions under which to collect the data, and specify tolerable limits on decision errors that will be used as the basis for establishing the quantity and quality of data needed to support decision-making. The DQOs are used to develop a scientific and resource-effective design for data collection. The seven steps of the DQO process for this TAPE project are presented in Table 3-1.

Background information for the Troy OU study area was discussed in Section 1 as was a draft site conceptual model (Figure 1-1). The Troy properties, where sources of vermiculite contaminated with LA may be found, are not predictable; DEQ has therefore determined that each property in the Troy OU (including privately-owned and publicly-owned property) will be investigated and screened. The properties may or may not contain a building, or multiple buildings; specific use areas (gardens, former gardens, flower beds, and play areas; all are areas with potentially greater exposure or greater use of vermiculite amendments); and yards and open space. Depending on the individual features for each property and building and the concentration of the LA, one or more of the four cleanup alternatives below will be applicable:

1. Clean the building attic by removing the vermiculite-containing insulation (VCI)
2. Clean the interior living space
3. Clean the outdoor LA-contaminated soil by removing the LA-contaminated soil
4. Take no further action at this time

The DQOs will be used to design the TAPE project so that the sampling and analysis are appropriate to select the correct alternative for each Troy property.

TABLE 3-1

DATA QUALITY OBJECTIVES
INVESTIGATION OF TROY OPERABLE UNIT

STEP 1: State the Problem
Troy, Montana, is located 18 miles from Libby, Montana. Libby is the site of a vermiculite mine and associated processing facilities that operated until 1990 and produced vermiculite insulation and other byproducts. The vermiculite deposit is contaminated with a form of amphibole asbestos (LA). Asbestos is a known and virulent carcinogen and is associated with a multitude of respiratory health effects, including asbestosis, lung cancer, and mesothelioma (DPHHS 2005). Some mine workers lived in Troy and commuted to the mine to work because Troy is close to Libby. The mine workers were exposed to LA-contaminated materials at the mine and processing facilities, and they may have transported contaminated dust to their homes on clothes and equipment. Vermiculite is used for insulation and soil amendments, and the vermiculite and waste rock (in various forms) were used in construction and for general soil amendments in Troy. VCI and waste materials have been documented in Troy. Properties in Troy should be investigated to evaluate whether LA-contaminated vermiculite has been transported to these sites and at concentrations that would pose health risks to the occupants. In 1999, in response to media reports EPA Region 8 dispatched an emergency response team to investigate high rates of asbestos-related deaths in Libby. Originally believed to be a problem limited to mine workers, the scope has increased. Subsequent environmental investigations have found many areas in Libby with LA contamination. EPA began Superfund emergency response removal actions in Libby in 2000 that are ongoing. The Montana DEQ is the lead agency for the Troy OU of the Libby Asbestos Superfund site. **The following are problem statements associated with the Troy Properties investigation:** • Exposure to LA-contaminated vermiculite is a threat to human health (EPA 2000c). • Respirable LA asbestos is released when source materials are disturbed (EPA 2000c). • Potential source materials include VCI, vermiculite waste products, and soils contaminated with LA. • Household dust and indoor air are potential exposure pathways. • LA-contaminated materials may be found randomly in and around Troy. • All properties within the Troy OU should be evaluated for the presence of LA-contaminated materials.

TABLE 3-1 (continued)

DATA QUALITY OBJECTIVES
INVESTIGATION OF TROY OPERABLE UNIT

STEP 2: Identify the Decisions

Principle Discussion Question: Is a remedial action required at a property to clean up LA contamination?

Sampling Decisions:

- Identify the number of potential properties to investigate by reviewing aerial photographs, defining individual properties, compiling addresses, and determining if the property could be individually bought or sold.
- Identify the number of buildings on each property within the Troy OU.
- Identify the number of specific use areas, yards, and open space areas on each property in the Troy OU.

Cleanup Decisions:

- Identify buildings with open, non-contained, or migrating VCI.
- Identify the individual levels (floors) within each building with LA in the indoor living space above cleanup criteria (EPA 2003b).
- Identify the properties with outdoor specific use areas or yards with LA-contaminated soils above cleanup criteria (EPA 2003b).
- Identify the properties and buildings where no further action is required at this time.

STEP 3: Identify Inputs to the Decisions

Figure 3-1 provides a graphic representation of the inputs described in Step 3.

Inspect the attics of buildings within the Troy OU to visually confirm open, non-contained, or migrating VCI.

- Inspect the living spaces of buildings within the Troy OU to visually confirm migrating VCI.
- Collect dust samples from each building level and analyze them to evaluate whether LA contamination exceeds the cleanup criteria.
- Inspect the outdoor areas of the property (specific use areas, yards, and open space) for visible vermiculite.
- Collect soil samples from each outdoor area and analyze them to determine if LA contamination exceeds the cleanup criteria. Figure 3-2 provides plan and cross-sectional views of the typical outdoor sampling that will be performed at each property.

STEP 4: Define Study Boundaries

- The Troy OU generally consists of the valley bottom from the north half of Section 25, Township 31 North, Range 34 West, and Section 30, Township 31 North, Range 33 West, east to the junction of Highways 56 and 2, and north to the northern edge of Section 21, Township 32 North, Range 34 West. Figure 1-2 shows the configuration of the study area for the Troy OU.
- Some properties (approximately 25) within the Troy operable unit have previously been inspected and sampled under the Libby OU4 investigation. Data have been recorded in the Libby database for these properties and will be integrated with additional sampling data from the TAPE.

TABLE 3-1 (continued)

DATA QUALITY OBJECTIVES
INVESTIGATION OF TROY PROPERTIES

STEP 5: Develop Decision Rules
• If VCI is visible in a building attic, then collect dust samples from the living spaces to evaluate whether LA concentrations exceed cleanup criteria. • If VCI is not visible in an attic, then collect dust samples from the living spaces to evaluate whether any secondary indoor source of LA has resulted in LA concentrations that exceed cleanup criteria. • If vermiculite is visible in a building interior, then collect discrete samples to support a small-scale vermiculite removal for the area. In addition, collect dust samples from the other building levels or areas to evaluate whether LA concentrations exceed cleanup criteria in those living spaces. • If vermiculite is not visible in a building interior, then collect dust samples from the living spaces to evaluate whether secondary indoor source of LA has resulted in LA concentrations that exceed cleanup criteria. • Collect discrete soil samples from specific use areas to evaluate whether LA concentrations exceed soil cleanup level. • If the property contains a yard and large open space, then subdivide these areas by similar land uses (for example, grassed areas, driveways, parking areas, and front, back, and side yards) and collect a composite soil sample from each subarea to determine if soils in any subarea contains LA at concentrations that exceed cleanup criteria (EPA 2003). • Figure 3-1 shows the steps used to inspect and sample buildings and exterior property in the Troy OU. Figure 3-2 provides some typical outdoor soil sampling designs for specific use areas, yards, and open spaces.
STEP 6: Specify Tolerable Limits on Decision Errors
• Sampling and measurement error are associated with environmental data collection and may lead to decision errors. Sampling error occurs when the sample is not representative of the true site conditions. Measurement error occurs because of random and systematic errors associated with sample collection, handling, preparation, analysis, data reduction, and data handling. Decision errors are controlled by adopting a scientific approach that uses hypothesis testing to minimize the potential for error. • There are two types of decision error: false negative error, and false positive error. A false negative decision error occurs when the null hypothesis is rejected although it is true. The consequences of a false negative error would be that VCI or LA-contaminated dust or soil at a Troy property is not remediated. A false positive decision error occurs when the null hypothesis is not rejected although it is false. The consequences of a false positive error are that unnecessary resources are expended to undertake remedial action to address contaminated media that do not exist at concentrations that exceed action levels or acceptable risk levels. • Property-specific sampling objectives and the random distribution of vermiculite and LA-contaminant soil limit the usefulness of statistical methods to eliminate sampling error. Therefore, sampling methods and procedures will be based on results from the Libby Asbestos Superfund Site. Tolerable limits on sampling decision errors cannot be precisely defined; however, the decision errors will be minimized by inspecting and screening all properties in the Troy operable unit. Decision errors based on analytical data will be minimized by the use of standard EPA-approved and Libby-specific analytical methods.

TABLE 3-1 (continued)

DATA QUALITY OBJECTIVES
INVESTIGATION OF TROY PROPERTIES

STEP 7: Optimize the Sampling Design
• All properties in the Troy OU will be uniquely defined in the work plan, and their locations will be identified using existing Lincoln County records, cadastral databases, and low-level aerial photographs. The number of Troy properties to be investigated will be approximately 1,000. Some houses and buildings likely are on multiple platted properties. • Dust and soil samples will be collected using similar methods and standardized procedures that have been employed for the Libby Asbestos Superfund site. With more than 4,000 Libby properties sampled since 2001, the methods have been defined (CDM 2002; CDM 2003a; CDM 2003b; EPA 2003a). • Field QA/QC procedures will be implemented and will include equipment decontamination, QA samples, field documentation, and sample chain of custody. Scientifically valid and legally defensible data will be supported by collection of dust and soil field blanks and other QA samples at a frequency necessary to assess potential cross contamination from equipment and sample integrity during collection. • Additional building and property details will be collected to support the pre-design inspections when visible triggers are noted during the TAPE inspection. Details may include, but are not limited to: ➢ Attics – type of attic; entry locations; vents; barriers in attic; dimensions; and approximate volume of VCI, ➢ Living spaces – number and types of rooms and hallways; ceiling conditions; and electrical, mechanical, and plumbing systems, ➢ Exterior – site sketches of existing landscape, improvements, and potential additional sample locations, ➢ Outside staging areas and electric service. • Field sample data sheets, similar to those used in Libby, will be completed for each sample collected and each property inspected within the Troy OU. The field data sheet information will be recorded onto electronic records that can be easily added to the existing Libby V2 database. • Dust and soil samples collected at each Troy property will be uniquely labeled, and sampling information will be recorded onto electronic records. The electronic sample records, along with the samples, will be transferred under chain-of-custody procedures to a CDM sample data coordinator, who will verify completeness and accuracy of the records. • Montana DEQ and its contractor, Tetra Tech, will work closely with EPA, Volpe, and its contractor, CDM, to ensure that sample integrity is maintained throughout and that data quality is adequate to meet project objectives. • CDM will transfer the electronic sampling and field form information to EPA and Volpe and prepare the samples for analysis. • Figure 3-3 provides a schematic diagram of the TAPE process used by Tetra Tech to organize, conduct the property evaluations and sampling, and provide samples and electronic information to CDM, EPA, and Volpe.

Figure 3-1 TAPE Inputs

Figure 3-2 TAPE Outdoor Soil Sampling Design

Figure 3-3 TAPE Inspection and Sampling Process Diagram

4.0 FIELD PROCEDURES

This section of the Troy work plan describes the field activities to be implemented for the TAPE inspection and sampling project and includes the following tasks:

- Mobilizing and demobilizing
- Obtaining access agreements
- Scheduling inspections with property owners
- Conducting verbal interviews
- Conducting property inspections – indoor, attic, outbuildings, outdoor, yard, specific use areas (using the inspection field form [IFF])
- Collecting indoor dust samples (recorded on field sampling data sheet [FSDS])
- Collecting outdoor soil samples (recorded on the FSDS)
- Collecting QA/QC samples
- Decontaminating equipment and personnel
- Containing and disposing of investigation-derived waste

SOPs are provided in Appendix B and are referenced throughout this section of the TAPE work plan. As appropriate, Tetra Tech personnel will use guidance developed specifically for the Libby Asbestos Superfund Site. Some of the Libby-specific guidance documents are listed below and copies are provided in Appendix B.

- CDM-Libby-03 (Revision 1) Completion of Field Sampling Data Sheets (FSDS)
- CDM-Libby 04 (Revision 1) Completion of Information Field Form
- CDM-Libby 05 (Revision 1) Site-Specific Standard Operating Procedure for Soil Sample Collection

Health and safety protocols and requirements will apply to all field activities and are summarized below. Information on quality control is provided in Sections 5.0 and 7.0 of this work plan.

4.1 HEALTH AND SAFETY PROCEDURES

The TAPE HASP (Appendix A) and Tetra Tech's corporate health and safety program plan will apply to all field activities undertaken as part of this project. All field staff conducting inspection and sampling activities will be required to:

1. Hold a current OSHA hazardous waste operations (HAZWOPER) 40-hour training certification and up-to-date 8-hour refreshers, as required under 29CFR1910.120;

2. Hold a current asbestos inspector training certificate;
3. Hold a State of Montana asbestos inspector license;
4. Have medical clearance to work wearing a half-face air purifying respirator; and
5. Be quantitatively fit-tested for the specific project respirator within the 12 months prior to the field activities.

The TAPE HASP in Appendix A provides detailed health and safety protocols and requirements, including directions for when to use PPE, such as respirators. All attic entries will be conducted in modified level C PPE that will include a half-face or full-face air purifying respirator with HEPA cartridges. Other property inspection activities, including dust sampling and soil sampling, will be conducted in modified level D PPE. Mr. Mark Stockwell will be the Tetra Tech Site Safety Officer for the field activities (see Table 2-1 of this work plan). Negative exposure assessments for the field teams will be performed as necessary, as described in the HASP and at the direction of the Site Safety Officer.

4.2 SITE ACCESS AND LOGISTICS

Section 4.2 provides information about community relations, logistics and schedules, and site access agreements and waivers.

4.2.1 Community Relations and Information Centers

Tetra Tech will coordinate with DEQ to ensure that sufficient public outreach (including public meetings, fact sheets, newspaper articles and notices, and radio announcements) is completed before and during implementation of the TAPE. Tetra Tech will provide personnel to attend public meetings in Troy and will help prepare presentation materials, at DEQ's request. Public outreach and information on the purpose and nature of the TAPE and its role in the overall investigations and cleanup at Troy and Libby are essential to its success.

Tetra Tech and DEQ will set up and staff a field office in Troy at least 1 month before and for the duration of TAPE field activities. The Tetra Tech field office will be the TAPE logistical center for obtaining property access agreements, scheduling field activities, returning samples and field forms at the end of the day, and transferring sample custody from Tetra Tech to CDM. The Tetra Tech field office will also provide a physical location and venue for people in Troy to provide and obtain information about the project. The Tetra Tech field office will also have telephones and answering machines for contacting project personnel when the office is not staffed and after regular hours (Monday through Friday 8:00 am to 5:00 pm).

The existing EPA Information Center in Libby will also be an information resource for Troy residents, providing access to major project documents. A free 1-800 telephone number will be established and maintained throughout the project to allow interested Troy residents quick and easy access to background information. The 1-800 telephone number for the Information Center will be advertised in the Troy community.

DEQ has established a repository for general and Troy-specific information at the City Hall in Troy, located at 301 E. Kootenai. The Troy City Hall is open Monday through Friday from 8:00 a.m. to 5:00 p.m. Tetra Tech and DEQ will continue to provide updated information in City Hall throughout the field sampling activities.

Section 2.0 of this work plan discusses the roles and responsibilities of the DEQ and Tetra Tech in community relations.

4.2.2 Logistics and Schedule

Tetra Tech will establish a field office in Troy for the duration of TAPE field activities. Tetra Tech will identify and provide all necessary personnel, sampling equipment, PPE, and project materials for implementing this work plan. All Tetra Tech field personnel will be trained not only in specific tasks but also on the overall objectives of the TAPE. This training will facilitate TAPE implementation and allow for effective communication with the public and other team members.

Tetra Tech personnel will include the TAPE project manager, who will oversee all project activities and logistics and will ensure that the lines of communication are maintained to resolve any issues or concerns that may arise during the field efforts. The Tetra Tech project manager will reside in Helena but will be at the project site in Troy for about 50 percent of the field activities. The TAPE field team leader will be based out of Troy and will be responsible for obtaining site access agreements, assisting with public outreach, scheduling daily field activities, and providing quality control and oversight of the five TAPE field teams. Tetra Tech will also provide a field sample coordinator to reside in Troy and assist the project manager and field team leader with daily project tasks. The field sample coordinator will have primary responsibility for checking and cataloging soil and dust samples at the end of each day and for working closely with the CDM field sample coordinator to ensure that complete, adequate, and secure sample information is collected and transferred to EPA. The detailed responsibilities for these Tetra Tech project personnel are further discussed in Section 5.5.

Tetra Tech will provide five two-person TAPE field teams stationed in Troy for the duration of the field effort. Some substitution and rotation of field staff on and off the TAPE project is expected, but the field staff will work a minimum of 2 weeks before substitutions occur. The Tetra Tech field team leader (Mr. Stockwell) will continuously accompany the field teams to ensure and verify that the teams are conducting the TAPE activities as described and outlined in this work plan. The Tetra Tech field teams may conduct limited TAPE inspections on weekends (both Saturday and Sunday) to better accommodate the schedules of Troy property owners. Both members of a field team will be HAZWOPER certified, hold current asbestos inspector licenses, and be trained to properly handle the health and safety protocols for this project.

On average, a Tetra Tech field team will complete three TAPE inspections per day, depending on the complexity of the properties inspected. With five field teams, Tetra Tech can complete an average of 15 total TAPE inspections per full day. If the field inspections continue uninterrupted, Tetra Tech could complete the inspections of more than 1,000 Troy properties in about 75 full work days, or within a 15 week time frame. Tetra Tech's projected schedule for completing the TAPE inspections will be finalized when additional funding is acquired.

4.2.2.1 Communications

Field team members will be provided with cell phones (which will necessitate use of a temporary cell tower), satellite phones, or multi-way radios for the duration of field activities. Contact information, including emergency numbers, for all field teams and for TAPE project management personnel in Helena, Montana, will be stored in the Tetra Tech Troy field office. In addition, the Montana DEQ TAPE Project Officer (Ms. Catherine LeCours), CDM Troy field sample coordinator, and EPA Libby Superfund project personnel will be provided with contact information for ready access to the Tetra Tech field teams.

4.2.2.2 Equipment

Appendix C details equipment and supplies Tetra Tech identified as necessary for the TAPE field activities described in this work plan. Equipment and supplies that are not immediately available to Tetra

Tech will be purchased or rented before TAPE field activities begin. Before purchased or rental equipment or supplies will be accepted, the Tetra Tech field team manager will inspect the goods to ensure they are in good condition and free of defects.

4.2.2.3 Pre-Field Activities

Before field crews mobilize to Troy for the TAPE field inspections, Tetra Tech will prepare detailed property maps that identify individual Troy properties. Property boundary and other details will be gathered from public databases (cadastral) and projected onto a high-quality, high-resolution air photograph. Individual Troy property maps will be used during the TAPE field inspections to record approximate locations of the specific use areas and yard samples collected at each property. These property maps will be field checked and may be revised as necessary during the inspections. Tentative inspection and sampling schedules may be based on a block-by-block TAPE inspection pattern. The TAPE inspection schedule will be refined as Tetra Tech schedules the inspections at times and dates convenient to the property owners.

4.2.2.4 Field Team Organization

Five field teams of two people per team will conduct the TAPE inspections and sampling. On average, 15 properties will be inspected and sampled per day. At the start of each day, the field teams will meet at the Tetra Tech field office for daily safety and organizational briefings (see Section 4.1 and Appendix A HASP).

Before the morning briefing, the Tetra Tech field team leader will have prepared a packet for each property to be inspected and sampled that day. Each packet will include:

- A copy of the signed access agreement,
- Details of the scheduled inspection date and time, and the name and telephone number of the property owner or the person who will be present for inspection and sampling, if different than the property owner,
- A property-specific verbal interview form,
- A property-specific IFF,
- A property-specific FSDS,
- Preprinted property-specific sample labels, and
- Two copies of the property parcel maps.

Additional TAPE inspection and sampling supplies (as described in Appendix C, list of supplies) will be kept at the Tetra Tech field office for use by the field teams. The daily briefings will be used to coordinate daily property inspections, calibrate sampling equipment, and collect supplies. The daily briefing will include a review of any issues or problems that arose the previous day, and will provide an opportunity for field team members to ask questions and share lessons learned. At the end of each day, field teams will return to the field office to deliver samples and paperwork to the Tetra Tech field sample coordinator, download digital cameras, charge rechargeable equipment, and store field equipment for the evening. Section 6.0 of this work plan contains additional logistical details on TAPE data management.

4.2.3 Access Agreements and Waivers

Approximately 1 month before TAPE field activities begin, Tetra Tech will assist DEQ with mailing information packets to every Troy property owner where the property has been identified for inspection and sampling. The information packet will contain information from DEQ on the proposed sampling and contact information for Tetra Tech Troy field office, DEQ, EPA, and the Libby Information Center. The packet will also contain a copy of an access agreement form, an inspection and sampling waiver form, and a postage-paid envelope for the property owners to return the completed access agreement or waiver form. The information packet will explain the need for the signed access agreement or waiver form and encourage any property owners who have questions or concerns about the process to contact the designated parties. An example informational packet is provided in Appendix D.

The Tetra Tech project manager and field team leader will manage information mailed in from the Troy property owners, including signed access agreements and inspection and sampling waiver forms. Two weeks after the informational packets have been mailed, a field team of two Tetra Tech personnel will follow up with properties where no response has been received. Follow up contacts (in person or by telephone) will explain the purpose of the TAPE, describe the inspection and sampling process, and answer any pertinent questions. The field teams will attempt to obtain a signed access agreement for each property and will return signed access agreements to the TAPE field team leader.

If property owners are not available during the reconnaissance, the field team will revisit each location at least three times, and the field team leader (or designee) will continue to follow up with personal visits and by telephone. After repeated attempts to contact the property owner by the field teams and the field team leader, Tetra Tech will repeat the mailing with a letter describing the attempts made to contact the property owner.

When the field team leader has received completed and signed access agreements either by mail or from a field team, Tetra Tech will contact the property owner by telephone to schedule a TAPE inspection and sampling visit. Based on information gathered during the scheduling telephone call, the field team leader may schedule the inspection and sampling of individual properties for reasons including, but not necessarily limited to:

- Remodeling efforts (if an area is exposed or accessible that otherwise would not be)
- Community events (holidays, school activities, fairs, or parades, for example)
- Limited times when property owner is available (for example, inflexible work schedule, childcare or caregiver responsibilities, out-of-area property owner, business activities at a commercial or industrial property, or related factors).

Tetra Tech will make reasonable efforts to find a TAPE inspection and sampling date and time that are convenient for the property owner. TAPE inspections and sampling schedules will include evenings (daylight hours only) and weekends, as needed based on the requests of property owners. If property owners respond to the access agreement favorably, but a property is currently uninhabited (for example, it is only seasonally occupied or is currently for sale, or no buildings are present on the property), Tetra Tech will attempt to inspect and sample the property with a designee of the property owner. Properties will not be exempted from inspection or sampling on the basis that they are currently uninhabited, however.

Tetra Tech will not advise property owners of the likely nature of removals at their properties or estimated removal dates during the TAPE scheduling phase, the personal interviews, or the TAPE inspections and sampling. Property owners will be advised that removals and schedules will not be determined until analytical results have been received and evaluated.

Property owners may choose to sign an inspection and sampling waiver to decline some or all inspection and sampling. The property owner may use the waiver form to decline access to a property for inspection, to allow only limited access to the property for inspection and sampling, or to allow access for inspection but not for sampling. Tetra Tech will maintain a list of all Troy properties for which signed waivers have been received. If limited access is allowed, the field team leader will schedule an inspection and sampling for the property. Tetra Tech will provide DEQ with the list of all Troy property owners who completed the waiver form and decline the TAPE inspection and sampling. Property owners will be advised that authorizing access for sampling does not obligate the property owner to likewise allow access for remediation; property owners will also have the option to choose to decline remediation, if DEQ proposes remediation.

Some Troy property owners may be non-responsive even when Tetra Tech has attempted to contact them by all reasonable means (telephone, visit to the property, and repeated mailings) to obtain permission for a TAPE inspection and sampling. When attempts to contact are unsuccessful, Tetra Tech will notify DEQ and will continue to attempt to reach the Troy property owner throughout the field sampling. Tetra Tech will provide DEQ with a list of all Troy properties where the property owner could not be contacted at the conclusion of TAPE field activities.

4.3 VERBAL INTERVIEW

The Troy property visit by the TAPE field team will commence with a verbal interview by the field team with the property owner to acquire background information about the property. The field team will interview the property owner using the questions provided on the interview form (Appendix E). Interview topics will include the known or suspected use of VCI in the house or outbuildings and possible introduction of other sources of LA within or near the property (including garden and landscaped areas and neighboring properties).

All buildings encountered during the TAPE inspections will be classified as a primary structure (habitable building, for example, a house, apartment, or main commercial space); or a secondary structure (non-habitable building, such as garages, shops, sheds, barns, or dog houses). The verbal interview will address all primary and secondary buildings and special use and yard areas located on a Troy property.

4.4 BUILDING INSPECTION, SAMPLE COLLECTION, AND RECORDING PROCEDURES

This section describes the inspection, sampling, and recording to be completed for each TAPE inspection.

4.4.1 Indoor Inspection

The two-person field team will visually inspect each building for the presence of VCI. One team member will access and inspect the attic (if safe, present, and reasonably accessible) and will inspect additional areas where VCI may be exposed in living spaces (crawlspaces, closets, and any wall openings). If VCI is observed, the field team member will estimate the quantity based on field measurements or visual estimation, with field measurements (length, width, and height of item) collected wherever possible.

The second team member will document results, including estimated quantities of VCI, on the IFF and will record additional pertinent information in the field logbook. As much as is possible in a non-destructive manner, the visual inspection will include checking under other types of insulation (such as blown-in or fiberglass insulation) for VCI. Visual inspections will not involve opening up walls or ductwork to inspect for VCI within the building wall cavities, but will include removal of a representative sample of electrical switch plates to inspect wall interiors. Furthermore, it will include inspecting ductwork in accessible, unfinished areas of the building for VCI. In particular, the field team will note whether utility conduits (including heat/cooling vents) run from the attic to the living space. Visual inspections will not include inspecting the roof.

Attics will be considered reasonably accessible if they can be reached by stairs, hanging stairs, or a stepladder. Attics will be inspected in a manner that, in the judgment of the field team, is not likely to release additional VCI into the living space. The field team will compare exterior roof lines and interior ceiling heights with attic interiors in an effort to identify isolated attic areas that may exist between the roof and the main attic, or between the attic and the interior ceilings. If isolated attics are found, they will be inspected if possible, and barriers between attic areas and access points will be described in the IFF. Attic inspections will also involve inspection of kneewalls (areas where the pitch of the roofline meets the walls). Kneewalls may be used for storage or to improve the finished look of an attic. Kneewalls will be accessed wherever possible, as these areas may provide additional information on construction material. (For example, kneewalls may have unfinished floors compared with the finished floors in the rest of the attic.) If trusses or bracing posts are present in the attic that may pose an obstacle to potential cleanup, these items will be briefly described in the inspection form.

The TAPE inspections will also include noting any special factors that may potentially assist with or impede remediation, if required. For example, some special factors that may be noted include the presence of fragile decorative trim or stonework, exposed electrical wiring in the attic, the type of materials stored if the attic is used for storage, the type of furniture if the attic is finished, indications of potential structural issues such as cracked ceilings or walls, or unusually narrow entryways or corridors. If potted plants are located inside the primary building, the field teams will note whether vermiculite-containing potting soil is present, as this type of soil could affect results of dust sampling.

The field team will note the location of the electrical shut off panel and fuse box, if located during the inspection, and the type of water source for the property (city water or private well). The information on electrical panel and water source will be used for planning in the event that remediation is proposed for the property. The exterior of each primary and secondary building (walls, foundation, and trim) will also be inspected for VCI.

As described in the HASP (Appendix A), the field team will not be required to access any attics, crawl spaces, or living areas if there is an unacceptable safety hazard, including biologic hazards. The field team will not inspect Troy properties for non-VCI and non-LA asbestos. However, damaged or friable suspect asbestos-containing materials that are observed in the inspection will be noted in the field notebook. This information may be of use in interpreting sampling results and planning potential remediation efforts.

The field team may choose to photo-document specific conditions in the building during the TAPE inspection for future reference. The property owner will be asked for permission before any photographs are taken.

TAPE inspections will be documented on IFFs (Appendix E) and in the field logbooks. Pertinent details will include, but are not limited to, identifying the primary and secondary buildings, defining attic spaces, and sketching on the detailed property maps.

As described in Section 4.3, buildings on a property will be classified as primary or secondary. Every primary building will be subject to a TAPE inspection, an IFF will be completed, and samples collected, unless the property owner declines access or sampling. Secondary buildings on Troy properties will be inspected, but only an IFF will be completed. No routine sampling in secondary buildings will be conducted; however, samples may be collected if the field team observes VCI in the secondary building or if the property owner indicates the building was historically used to store VCI.

4.4.1.2 Record Building Locations with GPS

As part of the TAPE inspection, the location of each primary and secondary building on the property will be recorded using the backpack-mounted Trimble XRS-Pro global positioning system (GPS). The GPS location will be recorded at the primary entrance to each building. Coordinates will be saved on the GPS with a unique identification number that starts with the notation “BD-XXXX,” where “BD” indicates a building location, and will also be recorded by the field team on the IFF and in the field log book.

4.4.2 Indoor Dust Sampling

Dust samples will be collected using microvacuum (microvac) sampling techniques in all primary buildings, regardless of whether VCI is observed. Dust samples will be collected in secondary buildings only if the building was reportedly used to store VCI or if VCI is observed. Dust samples will be collected following the procedures provided in American Society for Testing and Materials (ASTM) *Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations* (D 5755-95). A copy of this standard ASTM method is provided in Appendix B, with site-specific applications described below (ASTM 1995).

The decision to use microvac sampling, rather than wipe sampling, for the TAPE inspection and sampling was based primarily on the need to collect data that are consistent with data collected for the Libby Asbestos Superfund Site. EPA, and its contractor CDM, have used microvac sampling methods to collect the indoor dust samples in Libby. Microvac sampling methods are assumed to collect samples that more accurately measure releasable asbestos fibers when compared with wipe samples. Each indoor dust sample will be composed of a three-point composite sample, as described in the above-mentioned ASTM standard (ASTM 1995).

4.4.2.1 Select Sampling Locations

The TAPE field team will select sample locations based on the team’s visual inspection of the buildings and estimation of where contaminated dust is most likely to be found. The number and locations of dust samples will be selected as described below.

Primary Buildings

Dust samples will be collected in every primary building regardless of whether VCI was observed during the visual inspection, unless the property owner declines sampling.

- Two dust samples will be collected on each level of the building’s living space (including finished basements):

- One three-point composite sample will be collected from accessible horizontal surfaces (for example, windowsill, shelving, and cabinets). The TAPE field team will select the surface or surfaces based on factors including proximity to observed VCI and dust accumulation. (Preference will be given to surfaces with higher dust accumulation that are closer to observed VCI.)
- One three-point composite sample will be collected from high-traffic walkways, which will be selected by the TAPE field team based on the most probably walkway for tracking contamination into the building, including walkways adjacent to entry doors on the main floor. It will include main walkways and corridors between living areas on upper floors and in basements without walk-out access. Walkways may be solid surfaces or covered with rugs and carpets, or a combination.

- One three-point composite sample will be collected from each unfinished basement, if present. This sample will be collected from both walkways and horizontal surfaces inside the basement, with specific aliquots selected at the discretion of the TAPE field team.
- One three-point composite sample will be collected from each attached garage or shop, if present. This sample will be collected from both high-traffic walkways and horizontal surfaces inside the attached building, with specific aliquots selected at the discretion of the TAPE field team.
- No dust samples will be collected in attics or crawlspaces or outside of the building (for example, ambient air).
- The field team may choose to collect additional, targeted dust samples if migrating VCI is observed in the living space of a primary structure. These data would be used to design small scale vermiculite removal actions if necessary.

Secondary Buildings

Secondary buildings will be subject to dust sampling only if VCI is observed in the secondary building, or if the property owner indicates that the building was historically used to store VCI.

- One three-point composite sample will be collected from horizontal surfaces and the entry walkway.

4.4.2.2 Dust Sample Collection

Collecting a microvac dust sample involves vacuuming dust from a surface and drawing the sample through a filter designed to capture particulates larger than 0.45 micrometers (µm). The ASTM method D5755-95 provides the procedural details for properly collecting a microvac dust sample (Appendix B, ASTM 1995).

The microvac device will consist of a battery-operated low-volume sampling pump connected to a 25-millimeter (mm) vacuum dust sampler cassette. The analytical laboratory will provide the cassettes in sealed bags and will be certified asbestos-free. The cassettes will contain a 0.45-µm mixed cellulose ester filter. A 6.35-mm diameter plastic tubing will be used to connect the cassette to the pump. A 25- to 37.5-

mm length of 6.35-mm diameter tubing will be used to create a "nozzle" on the cassette for sampling. The nozzle tubing will be cut at the sampling end at an approximate 45-degree angle.

The pump will be calibrated each morning in the Tetra Tech field office using a standard calibration device such as a Dry-Cal. The pump will be calibrated using a 25-mm vacuum dust sampler cassette to simulate field operation. The flow rate used for sampling will be approximately 2 liters per minute, which provides an approximate air velocity of 100 centimeters per second through the 6.35-mm diameter tubing.

The sampling area for each dust sample point (aliquot) will be 100 square centimeters (cm^2) delineated using a fixed template or set of rulers. The aliquot sample will be collected by activating the pump and passing the angled nozzle across the delineated surface for 2 minutes.

Each indoor dust sample will contain three sample aliquots; that is, three separate 100 cm^2 surfaces will be vacuumed using one cassette. The cassette will therefore contain dust from a total 300 cm^2 surface area. To collect aliquots, the pump will be turned off and the sampling device moved to the next sample point. Once the next aliquot area has been delineated using a template or rulers, the pump will be turned on and the next 100 cm^2 surface area will be vacuumed. When all three sample aliquots have been collected, the sampling device will be turned upside down so that any loose dust falls into the cassette. The exterior of the cassette and nozzle will be wiped clean with a wet towel (wet wipe). The cassette will be detached from the pump, and both the cassette and the nozzle will be placed in a Ziploc sample bag for shipment to the laboratory (see Appendix B for detail). The nozzle will be included in the shipment because significant quantities of dust can remain in the nozzle. The sample will be labeled using the pre-printed sample labels and will be wrapped in bubble-wrap for shipment. Chain-of-custody procedures will be followed as described in Section 5.5.2.

Indoor dust sample point locations will be described and recorded in the TAPE field log book and on the FSDS and may be photographed and sketched on the property map at the discretion of the field team.

4.4.3 Outdoor Inspection

All areas of the Troy properties that are not covered with buildings will be inspected for vermiculite product in soil and surface materials. The areas of the Troy properties that are not covered by buildings will be grouped into two general types: (1) outdoor yards and open space, and (2) specific use areas. Figure 3-2 provides typical outdoor soil sampling designs for these two general types of outdoor areas.

Special attention will be paid to areas where known sources of LA may have been introduced (including fill areas) and to "high traffic areas" where potential LA is likely to be tracked indoors. The TAPE field team may further subdivide the outdoor yards and open space by land use types, such as yards or grassy areas; driveways; parking areas, and filled areas, if known or visible. Sketches will be drawn on the individual property maps to show the separate land use areas. The property sketch will also show fences, large trees, or other potential obstructions to potential future remediation. Properties that do not have yards, such as commercial properties, will be described as such on the IFF and in the field logbooks; outdoor areas such as paved parking or driveways will still be inspected. As best identified by the property owner, property boundary lines will also be noted on the IFF.

One member of the TAPE field team will visually inspect each area for the presence of vermiculite product or LA-containing rock while the second team member documents the locations and estimated quantities of observed vermiculite product on the IFF and in the field log book. Locations of vermiculite product observed will also be sketched on the property map. Visual outdoor property inspections will not include digging below the soil surface or destructive techniques to investigate underneath asphalt or concrete. It will not be necessary to delineate the vertical extent of contamination because the default excavation depth for remediation of specific use areas is 18 inches below ground surface (EPA 2003b). Similarly, the default excavation depth for remediation of general yard areas, open space, and driveways is 12 inches below ground surface (EPA 2003b).

Specific use areas include current and former flower beds, current or former gardens, planters, compost piles, play areas, and stockpiles. These areas will be included in the inspection. Visual inspections of specific use areas will not include digging below the soil surface.

As part of the yard visual inspection, the field team will note the location of visible utilities (overhead and buried, if marked) and will ask the property owner for any additional information on utility locations. Information on utility locations may be used for planning, but will not satisfy the utility locate requirements for the State of Montana should excavation be required for remedial activities. The field team may elect to photo-document specific conditions on the property for future reference. The property owner will be asked for permission before photographs are taken.

4.4.4 Outdoor Soil Sampling

After the visual inspection of the property has been conducted, the TAPE field team will collect soil samples from special use and yard areas following the procedures described below and in the SOPs in Appendix B. Soil will be sampled regardless of the results of the visual inspection. Soil sampling will include the following steps:

- Identify sampling locations
- Collect samples
- Record locations on Troy property map
- Record sample locations using GPS

4.4.4.1 Identify Sampling Locations

TAPE soil samples will be collected as five-point composites with composite subsamples taken from similar use areas. Typical designs for outdoor soil sampling are shown graphically on Figure 3-2. It can be assumed that LA sources would have been distributed across an area, for example by tilling into a yard or garden. A minimum of one five-point composite soil sample will be collected at each Troy property, unless the property has no soil-covered areas (for example, all outdoor areas are paved). A five-point composite will also be collected from the specific use areas; however, the size and dimensions of the specific use area may require that less than five subsamples be collected for some specific use areas. At least one five-point composite sample will be collected from the yard area. In general, five-point composite samples will not cover more than approximately 5,000 square feet. A maximum of five, five-point composite samples will be collected at each property, but additional composite or grab samples may be collected at the discretion of the TAPE field team. The Tetra Tech TAPE field team will use professional judgment to select the appropriate numbers of soil samples to collect at each property. In addition, the TAPE field team will collect all soil samples with the minimum amount of disturbance to the surface. Sod will be carefully removed and immediately replaced after sampling and care will be taken to collect soil samples without disturbing growing flowers and vegetables. To ensure consistency, all TAPE field teams will be provided the same training and guidelines, and training will include “brainstorming” potential property scenarios and discussing proposed sampling approaches.

4.4.4.2 Collect Soil Samples

Soil samples will be collected from (1) outdoor yards and open spaces, and (2) specific use areas at properties in the Troy OU. Figure 3-2 provides typical outdoor soil sampling designs for these two types of outdoor areas.

A typical Troy yard sample will be composed of a five-point composite soil sample collected from the 0 to 1 inch depth. As shown in Figure 3-2, the five individual sample points that will make up each composite sample will be located within a similar land use area, such as the back yard, front yard, or side yard. A minimum of one five-point composite sample will be collected from each Troy OU property with a yard. Additional five-point composite samples will be collected when the yards are larger than 5,000 square feet.

A typical open space sample will also be composed of a five-point composite soil sample, as shown on Figure 3-2, collected from the 0 to 1 inch depth. Typical spacing for the individual five-point locations are shown as approximately 30 feet, but this distance can be modified to best fit the land use area. Additional five-point composite samples will be collected for each open space area of approximately 5,000 square feet. The Tetra Tech field team will use professional judgment to select the appropriate number and type of soil samples to collect for each yard and open space. Not all open spaces may be sampled, depending on current and historical uses. To ensure consistency, all field teams will be provided the same training and guidelines, and training will include "brainstorming" potential property scenarios and discussing proposed sampling approaches.

Specific use areas in Troy include outdoor gardens, former gardens, flower-beds, play areas, and other areas with potentially greater exposure or greater use of vermiculite amendments. Five-point composite soil samples will be collected from the 0 to 6 inch depth interval in specific use areas. Figure 3-2 presents typical layouts for a garden plot, flower bed, and undefined areas. Typical sample spacing shown on Figure 3-2 is for 10 feet separation, but the distance can be modified to best fit the specific use area. The TAPE field teams will be provided training and guidelines for consistent sampling of specific use areas.

Hand trowels will be used to collect approximately 500 grams of soil sample from the 0 to 1 inch or 0 to 6 inch soil interval at each subsample location. Subsamples will be placed in a stainless steel mixing bowl and mixed with a stainless steel sampling spoon for approximately 3 minutes. After they have been combined, the mixed subsamples will be placed into one Ziploc bag using the same stainless steel mixing spoon. During sample collection and mixing, the field team will attempt to shield the soil samples from the wind to avoid potentially losing lighter fractions of the soil to the ambient air.

The Ziploc bag will be placed inside a second bag as a precaution. The outer Ziploc bag will be labeled using the pre-printed sample labels for shipment. Chain-of-custody procedures will be followed as described in Section 5.5.2.

The field team will attempt to restore the land surface to its prior condition after sampling, but Tetra Tech will not be responsible for re-laying sod or replanting. It is not envisioned that sampling will require large-scale disturbance of yards, since the sample size required is small.

4.4.4.3 Record Sample Location on Troy Property Map and with GPS

The field team will mark each soil subsample location on the Troy property map with labeling to indicate the composite sample for which the subsample was collected. A backpack-mounted Trimble XRS-Pro GPS will be used to record the midpoint subsample location for each composite soil sample. The GPS location coordinates will be recorded on the GPS unit with a unique identification number that starts with the notation "TSP-XXXX" where "TSP" indicates a "Troy Sample Point" soil sample. The GPS coordinates will also be recorded in the FSDS and field logbook for backup and verification of sample locations.

4.4.5 Photography

Each TAPE field team will have a camera for photo-documenting the conditions at a property, if the conditions are not readily described in writing or if, in the judgment of the field team, photographs may assist in development of a remedial action plan for that property. Permission from the property owner will be obtained before any photograph is taken, other than for photographs taken from the public right-of-way.

All photographs will be recorded in the field logbook and on the IFF, and on the property map using the following symbol to indicate the position where the photograph was taken and the direction it was taken (•→). No accurate distance scales will be used for landscape photographs, but general distances can be estimated by noting the location where the photograph was taken. All photographs will be taken using digital cameras and will be download the same day at the Troy Tetra Tech field office and saved.

5.0 FIELD QUALITY CONTROL PROCEDURES

Section 5.0 describes the methods and procedures for decontamination, quality assurance samples, field documentation, handling investigation-derived wastes, and maintaining chain of custody of samples and records.

5.1 EQUIPMENT DECONTAMINATION

Dust samples will be collected using laboratory-provided filter cassettes with a new cassette for each sample collected. In addition, new tubing will be used to connect the cassette to the air pump and to the end of the cassette for each sample collected. The air pump will not require decontamination between samples as a matter of course because of its position behind the sample filter during sample collection. If the exterior of the air pump becomes visibly dusty, it will be wiped clean with a damp paper towel to avoid transferring dust from one location to another.

The 100 cm^2 template or set of rulers used to delineate dust sampling area will be wiped clean with wet wipes between sampling locations.

The stainless steel mixing bowl, spoon, and trowel used for the composite soil sampling will be decontaminated between samples by removing surface soil and wiping clean with wet paper towels. If outdoor conditions create wet or muddy samples, the sampling equipment may require washing with soapy water (Alconox solution) and a wet brush until no visible soil remains. Clean water will be used for the final rinse, and the sampling equipment will be dried with paper towels.

Visible soil on hands or clothing will be removed by dry brushing or by washing with soap and water. No additional personnel decontamination is expected to be necessary. PPE will include disposable gloves, work boots, and respirators. The respirators will be cleaned and decontaminated as discussed in the HASP (Appendix A).

5.2 QUALITY ASSURANCE SAMPLES

Dust field blank samples will collected at a frequency of one blank sample per 20 samples, or at 5 percent. Field blank dust samples will be collected at locations selected by the TAPE field team, and will be collected by attaching a cassette to the pump and pumping for 1 minute at the same rate as for dust sample collection. However, the cassette will not have a nozzle, and the end of the cassette will be exposed to indoor air at the selected sampling location, rather than passed over a surface of any kind. Data for the dust field blank samples will be evaluated to assess whether a potential exists for airborne asbestos to cause analytical detections of asbestos in dust, or for cross-contamination to occur during sampling. Dust lot blank samples will also be submitted by the laboratory for each lot or batch of cassettes received from the laboratory. Data for dust lot blank samples will be used to evaluate whether cartridges were received asbestos-free from the laboratory.

Soil field equipment blanks will be collected at a rate of one per calendar week (Monday through Sunday) of sampling per field team. Field equipment blanks will be collected by placing silica sand (that is asbestos-free as analyzed by polarized light microscopy [PLM]) in a decontaminated stainless steel mixing bowl. The silica sand will be mixed in the bowl using the decontaminated equipment that was used to collect the soil samples. The silica sand will then be containerized and submitted for analysis following the same PLM methods. Data from field equipment blank samples will be used to evaluate the effectiveness of equipment decontamination between sampling locations or, in other words, the potential for cross-contamination between samples. Based on results for field equipment blanks, the frequency for soil field equipment blanks may be increased at the discretion of the Tetra Tech project QA/QC manager (however, the frequency will not be decreased to below one sample per week).

Soil field duplicate samples will collected at a frequency of one blank sample per 20 composite soil samples or a rate of 5 percent. Field duplicate samples will be collected as samples collocated in the same land use area (yard or landscaped area, for example) and will contain the same number of subsamples (typically five), but will be collected from different subsample locations. Data for soil field duplicates will be used to evaluate the potential variability in LA concentrations in a specific land use area. These data will not be used to evaluate precision in sampling or analytical techniques.

5.3 FIELD DOCUMENTATION

Example field forms (interview forms, IFFs, and FSDS) are provided in Appendix E. Before the TAPE field activities begin, all members of the Tetra Tech field team will receive the same training on implementation of this work plan in general and on use of these forms in particular. Property owner interviews, property inspections, and sample collections will be conducted using these forms to ensure consistency between properties and between TAPE field teams. Use of these forms will also allow compilation of TAPE-derived data into the Libby V2 database (see Section 5.5).

Any additional information that is not recorded on field forms will be recorded in the TAPE field logbooks. Each field team will maintain a field log book for recording the date and time of each property inspection, the names of the people who allowed property access and completed the interview, the property-specific ID number and IFF number, the number and type of samples collected at the property including sample ID numbers and FSDS numbers, chain of custody numbers, and any other pertinent information. A new page will be started in the field log book for each property. The field logbook will serve as an independent (backup) record for all activities conducted and samples collected at a property, in the event that IFFs or FSDSs are lost or damaged. The field logbook will also be used to record additional observations of the field team that relate to potential remedial action at a property, such as locations, quantities and types of suspect asbestos-containing material that is not VCI or LA, and access limitations that were not noted on the IFF.

Information will also be recorded on the individual property maps by sketching directly onto the property maps, which will have an aerial photograph base. Property map sketches will show the locations of any observed VCI and LA-containing rock, primary and secondary buildings and the main entrance of each building, and the outdoor sample (including subsample) locations.

5.4 CONTAINMENT AND DISPOSAL OF INVESTIGATION-DERIVED WASTE

Investigation-derived waste will include used wet wipes, wet paper towels, disposable gloves, used respirator cartridges, used plastic tubing, decontamination water, and other minimal waste. It is possible, but not likely, that these investigation-derived waste materials may contain some asbestos. Therefore, all investigation-derived waste will be double-bagged and labeled with asbestos labels and stored at the Tetra Tech field office until it can be properly disposed of at an approved landfill. Non-sampling waste generated by the TAPE field teams, such as food containers and waste paper, will be separately bagged and disposed of as solid waste at a solid waste landfill.

5.5 RECORD KEEPING AND CHAIN OF CUSTODY

At the end of each day, or more often if required, the TAPE field teams will return to the Troy Tetra Tech field office to transfer the dust and soil samples, IFFs, interview forms, and FSDSs to the Tetra Tech sample coordinator (or the coordinator's designee). All verbal interview forms, IFFs, and FSDSs will be compiled at the Troy field office, photocopied, and the original copies forwarded to the Tetra Tech office in Helena, Montana, on a weekly basis. An individual file will be maintained for each property inspected.

Photocopies of all field forms and appropriate log book pages in each individual property file will be maintained in the Troy field office for the duration of the TAPE project so that information is available if questions arise. The original forms will be stored in the Tetra Tech office in Helena, Montana, for the duration of the sampling, inspection, and reporting phases of the TAPE project. The original forms will be transferred to DEQ at the end of the TAPE project. Copies of the field forms and field logbook will be available on request at any time during the TAPE project to DEQ, EPA, or to the Troy property owners.

After the field forms have been received from the TAPE field teams, the Tetra Tech field sample coordinator will manually enter the information into electronic format for ultimate transfer to the Libby V2 database. The Tetra Tech field sample coordinator will verify that the data were entered and correct and then transfer the electronic data to the CDM Troy coordinator, along with hard copies of the field forms and the associated dust and soil samples collected for the Troy properties. The CDM Troy coordinator will conduct a 100 percent data check to ensure that all information has been entered correctly. When the data check is complete, the CDM Troy coordinator will export the data to the Libby V2 database, via Volpe.

At the end of each day, or more often if needed, the TAPE field teams will return to the Troy Tetra Tech field office to complete chain-of-custody forms for all dust and soil samples, including QC samples, collected earlier. Until they have been transferred to the CDM Troy coordinator, all TAPE dust and soil samples will be held by Tetra Tech. Samples may be stored in locked vehicles or in a secured (locked) area of the Troy Tetra Tech field office. All TAPE dust and soil samples collected from the Troy properties, including QC samples, will be transferred along with a signed chain of custody form to the CDM Troy coordinator at least on a weekly basis. The CDM Troy coordinator will be required to sign the chain of custody forms to acknowledge receipt of the samples. The CDM Troy coordinator will provide Tetra Tech with a copy of this chain of custody. The CDM Troy coordinator will then transfer the samples to the laboratory for preparation and analysis.

Digital photographs will be downloaded daily to a computer at the Tetra Tech Troy field office. Photographs will be downloaded and labeled using a standard labeling procedure that is based on property-specific ID numbers.

6.0 DATA MANAGEMENT

Data management during the inspection and sampling will be under the supervision of the Tetra Tech TAPE field sample coordinator in the Troy field office. At the conclusion of inspection and sampling, that responsibility will pass to the Tetra Tech TAPE project manager.

6.1 DATA REQUISITION

The laboratory will report all analytical data to CDM, and CDM will oversee integration of that data into the Libby V2 database. Tetra Tech and DEQ will obtain sampling data from the Libby V2 database by requesting that data from Volpe (through EPA) on a standard information request form. Tetra Tech will request the following information from the Libby V2 database for each sample, including QC samples, collected during the TAPE project:

- Sample location
- Sample name
- Sample date
- Sample results
- Identification numbers, dates, and results for laboratory quality control samples

Volpe will provide this information (through EPA) in the standard Libby V2 data report format. All other information necessary for reporting purposes will be obtained from Tetra Tech internal files (copies of IFFs, FSDSs, property sketches, and log books).

6.2 DATA REPORTING

Data from the Libby V2 database will be obtained through a geographic information system interface software (ArcView). This interface will provide maps showing all TAPE sample locations. Dust and soil sampling results will be provided from the Libby V2 database in tabulated form, as Microsoft Access files. Tetra Tech will prepare a TAPE project report that describes the activities conducted, the results of the property inspections, and the results of the sampling, evaluates data quality, and recommends follow-up actions. The TAPE project report will include maps for each property where asbestos in soil or in dust exceeded screening levels. TAPE project maps will show sample locations and results for the property and delineate the areal extent of asbestos.

7.0 QA/QC PROCEDURES

The TAPE quality objectives, QC checks and samples, and audits completed for the TAPE project are described in the sections below. Field quality control procedures are described in Section 5.0 above.

7.1 QA/QC OBJECTIVES

The quality objectives of the TAPE project are to obtain 100 percent usable and accurate data. These data will be achieved through inspection and sampling using standardized field forms and procedures, auditing field operations, observing chain of custody procedures, and analyzing field quality control samples and laboratory quality control samples. The DQOs are further discussed in Section 3.0 of this work plan.

7.2 INTERNAL QC CHECKS

When laboratory analytical data are received, Volpe will conduct a thorough quality review of that data. Volpe will review data from both laboratory QC samples described below and field QC samples described in Section 5.2. Standard protocols exist for validation of soil samples analyzed by PLM for asbestos and will be followed. Standard protocols do not exist for validation of dust samples for asbestos; however, Volpe (and EPA) will follow the QC review procedures for dust data established at the Libby Asbestos Superfund Site. Volpe will prepare validation and review packages for all TAPE data and will transmit the reports to Tetra Tech to be included in the TAPE project report.

Dust and soil samples will be analyzed by one of EPA's contract laboratories following Libby Asbestos Superfund Site protocols, including EPA's most recent protocols relating to QA/QC for the Libby Asbestos Superfund Site. As such, the QA/QC protocols followed by the laboratories are not within Tetra Tech's immediate control.

Laboratory QA/QC samples and standard protocols that the contract laboratory will perform for routine analysis will include the analysis of the following sample types:

- Preparation Duplicate Samples
- Preparation Laboratory Equipment Blanks (grinding and other equipment)
- Method Blank Samples
- Matrix Spike/Matrix Spike Duplicates
- Laboratory Control Samples/Laboratory Control Duplicates

- Standard Reference Material
- Surrogates

Volpe will enter data into the Libby V2 project database with a 100 percent QC of the data. This check will be performed daily on the data entered from the previous day.

7.3 AUDITS, CORRECTIVE ACTIONS, AND QA REPORTS

Field audits will be an integral part of Tetra Tech's field operations for the duration of the TAPE project. Field audits and corrective actions will be the responsibility of the Tetra Tech QA/QC manager. (See Section 2.0 and Table 2-1 for designated key project personnel.) The TAPE project report will include a discussion of data quality that will include a summary of field audit results. Copies of field audit forms will be provided as an appendix to the TAPE project report.

7.3.1 Field Inspections and Sampling Procedures Audits

The Tetra Tech QA/QC manager will be responsible for audits of TAPE field inspections and sampling procedures. Audits will be conducted daily for the first 5 days of inspection and sampling and at least biweekly for the duration of the TAPE. Audits will consist of the QA/QC manager or his designee attending a Troy property inspection and sampling event and observing the TAPE field team's activities. The field team will not be warned of the audit. The auditor will compare the field team's activities with the protocols provided in this work plan and the attached SOPs and evaluate compliance with the protocols using the audit form provided in Appendix E. After the audit, the auditor will provide the completed audit form to the DEQ and Tetra Tech project managers.

7.3.2 Corrective Action Procedures

The QA/QC auditor may use his or her discretion to provide immediate verbal feedback to the TAPE field team if necessary to ensure that deficiencies are fixed as quickly as possible. The Tetra Tech field team leader and QA/QC manager will review the report with the TAPE field team within 48 hours of the audit to correct any deviations or deficiencies. If any deviations or deficiencies were noted, the field team will be audited again within 1 week of the original audit to ensure that any deficiencies have been fixed.

If gross deficiencies are noted, the Tetra Tech QA/QC manager will determine whether re-inspection or re-sampling of any Troy properties is required. Re-inspection or re-sampling will be required only if the

TAPE field team failed to correctly identify VCI during inspection, collected samples incorrectly, or collected a grossly inadequate number of samples.

7.3.3 Laboratory Audits

The EPA contract laboratories used to analyze the Troy project samples will be required to provide proof of current certifications. Examples of certifications include the following: American Industrial Hygiene Association and the National Voluntary Laboratory Accreditation Program. The verification of laboratory certifications and QC controls will be under the jurisdiction of Volpe or EPA. These agencies are responsible for conducting the laboratory audits if required.

REFERENCES

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APPENDIX A

SITE-SPECIFIC HEALTH AND SAFETY PLAN
TROY ASBESTOS PROPERTY EVALUATION

APPENDIX B

STANDARD OPERATING PROCEDURES (SOPs)
TROY ASBESTOS PROPERTY EVALUATION

CDM/EPA – Libby

- CDM-Libby-03 (Rev 1) Completion of Field Sampling Data Sheets
- CDM-Libby-04 (Rev 1) Completion of Inspection Field Forms
- CDM-Libby-05 (Rev 1) Site-Specific Standard Operating Procedure for Soil Sample Collection

American Society for Testing and Materials (ASTM)

- ASTM D5755-95 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Building Number Concentrations

APPENDIX C

EQUIPMENT/SUPPLIES LIST
TROY ASBESTOS PROPERTY EVALUATION

APPENDIX D

INFORMATION PACKET FOR RESIDENTS
TROY ASBESTOS PROPERTY EVALUATION

To be developed in conjunction with DEQ

APPENDIX E

FIELD FORMS
TROY ASBESTOS PROPERTY EVALUATION

This appendix details equipment and supplies identified by Tetra Tech as necessary for the field activities described in this SAP:

Rental equipment:
6 battery-operated low-flow air pumps
Calibration for pumps (Dry-Cal?)
5 Trimble pro-XRS GPS units
5 digital cameras
6 Phones/radios (one for field office, one for each team)
Vehicles

Purchase/From Supplies:
2 laptop computers

Inspection:
10 clipboards
6 x 50-foot tape measures
Palette knives, etc. (for looking under insulation)
5 stepladders (for attic, barn inspections)
Scale bars for photographs
Field log books

Sampling:
¼-inch diameter plastic tubing
Pocket knives
Ziploc bags
Duct tape
Wet wipes
Waterproof permanent markers
15 x 100 cm^2 templates
20 x 25-cm rulers
10 x Trowels
6 x Stainless steel mixing bowls
Steel sampling spoons
Sample labels
Silica sand (asbestos-free) for soil field blanks
Secure shipment containers
Bubble wrap for cassette shipment
Trash bags

PPE:
Respirator for each asbestos inspector
Replacement particulate respirator cartridges
Vinyl/nitrile gloves, various sizes

Decon:
Paper towels
Bristle brushes
Water spray bottles
5-gallon buckets
Surfactant (Alconox)

Lab-supplied:
Microvacuum dust sampling cassettes
Chains of custody
Sample shipment security seals
Cassette lot blank samples

Field Forms:
IFFs
SCDCs
Verbal interview forms
Field audit forms

Field inspection and sampling audit form

Audit completed by: ____

Audit date: ____

Field team members: ____

Property under inspection: ____

Inspection Item	**In compliance?**		**Notes**
	Yes	**No**	
Inspection date and time recorded in field book?			
Correct IFF and property maps used?			
Verbal interview conducted completely?			
Verbal interview recorded in interview form?			
Property owner’s questions answered?			
Attic is inspected?			
Respirator is used to inspect attic?			
All levels of primary structure are inspected?			
Field team noted all visible VCI or VCBM?			
Secondary structures are inspected?			
Property sketch is completed per SAP, using key?			
If taken, photographs have scale bars?			
Appropriate number of dust samples and subsamples collected?			
Dust subsample locations and areas are appropriate?			
Dust sampling equipment assembled correctly?			
Pump flow rate is 2 liters per minute?			
Dust sample is collected following SOP?			
Dust sample is recorded correctly on FSDS and in field log book?			
Dust sample labels are correctly attached to sample and field forms?			
Chain of custody procedures are followed?			
Dust samples are stored appropriately?			
Equipment is decontaminated appropriately?			
Waste is handled appropriately?			
Yard is inspected?			
Property sketch is completed per SAP, using key?			
Appropriate number of soil samples and subsamples collected?			
Soil subsample locations are appropriate?			
Soil samples are composited per SOP?			
Soil samples are containerized per SOP?			
Soil sample is recorded correctly on FSDS and in field log book?			

Inspection Item	**In compliance?**		**Notes**
	Yes	**No**	
Soil sample labels are correctly attached to sample and field forms?			
Chain of custody procedures are followed?			
Soil samples are stored appropriately?			
Equipment is decontaminated appropriately?			
Waste is handled appropriately?			
Gloves are worn for soil sampling?			
Field notes and forms are legible?			
Other (please describe):			

Additional notes:

Auditor signature: ____ Date: ______________

This form has been reviewed with the field team by the field team leader

Field team leader signature: _________________________________ Date: ____________

Field team members: _______________________________________ Date: ____________

_______________________________________ Date: ____________

Additional corrective actions taken:

Action: ____

Taken by: ____ Date: ______________

Action: ____

Taken by: ____ Date: ______________